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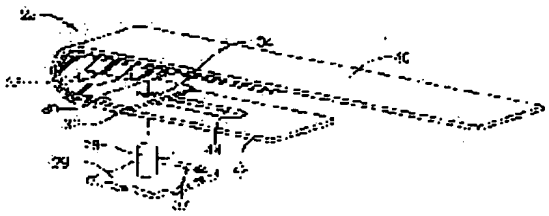
(54) KINETIC ENERGY ABSORBER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a kinetic energy absorber suited to be used as shock absorbing steering column.

SOLUTION: This kinetic energy absorber includes plastic-deformable first and second members 30 and 40 having traveling bite, a pusher 28 approaching to a first part of the first member 30 and fitted to a first body, a catch 44 allowing the second member 40 to move by a limited distance relative to the pusher 28, and an anvil device 35 fixed to the second body. The anvil device 35 is so positioned as to be approached to the traveling bite having a shape corresponding to the anvil surface 35. The anvil device pushes the traveling bite of the first member 30 in a first relative movement between the first and second bodies, moves along the length of the first member 30, pushes the traveling bite of the second member, and moves along the length of the second member.



* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1]The 1st member that has traveling bite in an energy absorption apparatus and in which plastic deformation is possible (30, 70, 110), The 2nd member with traveling bite in which plastic deformation is possible (40, 80, 120), A pusher which is attached to the 1st main part (29, 41, 85, 135), and approached with the 1st portion of said 1st member (30, 70, 110) (28, 66), Said 2nd member (40, 80, 120) is the catch who enables it to move only distance limited about said pusher, . When there is a limit in said distance and this is exceeded, the 1st portion of said 2nd member (40, 80, 120) is effectively fixed in said pusher. They are a catch and the Ambil device (35, 68, 96) fixed to the 2nd main part (45, 86, 137), Approach with said traveling bite, and it is positioned and said traveling bite, Have the Ambil device which has the Ambil side of said Ambil device (35, 68, 96), and corresponding shape, and said Ambil device (35, 68, 96), pressing said traveling bite of said 1st member (30, 70, 110) at the time of relative displacement of the beginning of said 1st and 2nd main parts -- said 1st member (30 and 70.) When it is constituted so that it may be made to move along with the length of 110, and said 1st and 2nd main parts continue relative displacement, When said traveling bite of said 2nd member (40, 80, 120) is moved along with the length of said 2nd member (40, 80, 120) and said catch results in said limit, Said 1st member (30, 70, 110) and said 2nd member (40, 80, 120) of said traveling bite are each the devices which absorb a lot of energy when moving one side caudad, and dissipate.
[Claim 2]A device in the device according to claim 1 in which said 1st member (30, 70, 110) is quite shorter than said 2nd member (40, 80, 120).
[Claim 3]In the device according to claim 1, to the move direction of said 1st and 2nd members, this area of a cross-section area of said 2nd member (40, 80, 120) is a larger device than said 1st member (30, 70, 110), when vertical.
[Claim 4]In the device according to claim 3, said cross-section area of said 1st member (30,

70, 110) and said 2nd member (40, 80, 120), Cover the operation length of said 1st member (30, 70, 110) and said 2nd member (40, 80, 120), and it is substantially fixed, and to said operation length. A device with which a part of said 1st member (30, 70, 110) that is started in a position of said traveling bite's beginning, and is finished with said free end, and said 2nd member (40, 80, 120) are contained.

[Claim 5]A device which contains metal straps in which plastic deformation of each of said 1st member (30, 70, 110) and said 2nd member (40, 80, 120) is possible in the device according to claim 1.

[Claim 6]A device with which one side of said 1st and 2nd main parts contains steering column housing (45, 86, 137), and another side of said 1st and 2nd main parts contains a vehicle body (41, 85, 135) in the device according to claim 1.

[Claim 7]In the device according to claim 1, said 1st member (30, 70, 110) and said 2nd member (40, 80, 120) are made and formed, and J form this form, Each 1st portion of the above is in a place of said said 1st and 2nd members (30, 40) which is each one 1st end (32, 42), Each 1st and 2nd members (30, 40) of the above have further said 1st end (32, 42) and the free end of an opposite hand, They are arranged mutual almost in parallel by each 1st end (32, 42) of the above, and said free end, and said traveling bite, Said 1st end (32, 42) is adjoined at first before said relative displacement of said 1st and 2nd main parts (29, 135, 137), A device which said 1st end (32) of said 1st main part (29, 135) is being fixed to said pusher (28), and is characterized by said 1st end (42) of said 2nd main part (137) including said catch.

[Claim 8]A device which said 1st member (30) and said 2nd member (40) receive mutually, and has become a nest in the device according to claim 7.

[Claim 9]A device with which one side of said 1st and 2nd main parts (45, 41) contains steering column housing (45), and another side of said 1st and 2nd main parts (45, 41) contains a vehicle body (41) in the device according to claim 7.

[Claim 10]In the device according to claim 7, said Ambil device (35) contains a sleeve (45), Can position this sleeve (45) as a center and a steering shaft said 1st main part (41), A device with which said free end of said 1st and 2nd members has extended along an axis of said sleeve (45) and said color (41) including a color (41) which can be arranged to the same mind focusing on said sleeve (45) in each.

[Claim 11]the [which has been arranged at about 180 degrees from said 1st and 2nd members (30, 40) in the device according to claim 10] -- the [the 2 1st member and (30), and] -- a device which contains the 2 2nd member (40) further.

[Claim 12]In the device according to claim 7, said pusher (28) contains a pin (28), Said 1st member (30) has a hole (34) at said 1st end (32), and said pin (28) is prolonged through this hole, By this, fix to said pusher (28) and said 1st end (32) said catch, A device which it has the

long and slender slot (44) formed in said 2nd member (40), and this slot collaborates with said pin (28), and enables said limited movement between said pin (28) and said 2nd member (40).

[Claim 13]In the device according to claim 1, said 1st member (30, 70, 110) and said 2nd member (40, 80, 120) make M form, and are formed, Each of said 1st and 2nd members (70, 80) The two free end which extends in the 1st direction at the whole (72, 82), Have the 2nd traveling bite and a central byte (74, 85) prolonged in said 1st direction at the whole, and said Ambil device (68), It has two Ambil sides (68) which approached with said traveling bite of said 1st and 2nd members (70, 80), and said 2nd traveling bite between said central byte (74, 85) and said free end (72, 82), and were positioned respectively, A device with which said pusher (66) approaches with said central byte (72) of said 1st member (70), and is positioned, and between said pusher (66) and said central bytes (85) of said 2nd member (80) is estranged for said catch.

[Claim 14]A device with which said 1st member (70) and said 2nd member (80) are a nest mutually in the device according to claim 13.

[Claim 15]A device with which one side of said 1st and 2nd main parts contains steering column housing (86), and another side of said 1st and 2nd main parts contains a vehicle body (85) in the device according to claim 13.

[Claim 16]In the device according to claim 13, said Ambil device (68), A device with which this hollow (89) contains a bracket (85) which can attach said pusher (66) to a body of a car including the said 1st and 2nd Ambil sides (68) including a hollow (89) formed in steering column housing (86).

[Claim 17]In the device according to claim 1, said 1st member (110) and said 2nd member (120), S form is made and formed and this form, each 1st portion of the above -- each of said 1st and 2nd members (110, 120) -- it being in one 1st end (112, 122), and each 1st and 2nd members (110, 120) of the above, A device which has an opposite end (126) further and is characterized by said traveling bite adjoining said 1st end (112, 122) before said relative displacement of said 1st and 2nd main parts (29, 135, 137).

[Claim 18]A device which each 1st end (112, 122) of the above and said opposite end (126) receive mutually, is almost parallel in the device according to claim 17, and has been prolonged in both directions.

[Claim 19]A device with which said Ambil device (96) is prolonged in the device according to claim 18 including at least three Ambil sides (97, 98) in inside of a flat surface where each 1st end of the above and said opposite end are common.

[Claim 20]A device with which said 1st member (110) and said 2nd member (120) are a nest mutually in the device according to claim 17.

[Claim 21]A device with which one of said the 1st and 2nd main parts (29, 135, 137) contains

steering column housing (137), and another side of said 1st and 2nd main parts contains a vehicle body (135) in the device according to claim 17.

[Claim 22]An energy absorption apparatus which absorbs kinetic energy by resisting compressive force which acts on said impact-absorbing steering column (76, 130) in an impact-absorbing steering column for kinetic-energy absorption is included, This energy absorption apparatus Steering column housing (45, 86, 137), Including the 1st member (30, 70, 110) in which plastic deformation is possible, and the 2nd member (40, 80, 120) in which plastic deformation is possible, said compressive force, It is done to said steering column housing (45, 86, 137), Displace said steering column housing (45, 86, 137), and it is sent at first not through said 2nd member (40, 80, 120) but through said 1st member (30, 70, 110), and at some points formed beforehand. Then, said compressive force passes said 2nd member (40, 80, 120) during said displacement, as for each of said 1st and 2nd members (30, 40, 70, 80, 110, 120), said member (30, 40, 70, 80, 110, 120) presses said traveling bite including traveling bite -- said member (30, 40, 70, 80, and 110.) A steering column which absorbs said kinetic energy by moving only the predetermined length of 120.

[Claim 23]A steering column in the steering column according to claim 22 in which said 1st member (30, 70, 110) is quite shorter than said 2nd member (40, 80, 120).

[Claim 24]A steering column with a larger cross-section area of said 2nd member (40, 80, 120) in the steering column according to claim 22 than said 1st member (30, 70, 110).

[Claim 25]In the steering column according to claim 24, said cross-section area of said 1st member (30, 70, 110) and said 2nd member (40, 80, 120), Cover the operation length of said 1st and 2nd members (30, 40, 70, 80, 110, 120), and it is substantially fixed, and to said operation length. A steering column with which said a part of 1st and 2nd members (30, 40, 70, 80, 110, 120) that are started in a position of said traveling bite's beginning, and are finished with said free end are contained.

[Claim 26]A steering column which contains metal straps in which plastic deformation of each of said 1st member (30, 70, 110) and said 2nd member (40, 80, 120) is possible in the steering column according to claim 22.

[Claim 27]In the steering column according to claim 22, said 1st member (30) and said 2nd member (40) make J form, and are formed, Each of said 1st and 2nd members (30, 40), Have the 1st end (32, 42) and the free end of an opposite hand of this 1st end (32, 42), and said 1st end of said 1st member (30), It is being fixed to a pusher (28) fixed to one side of the bodies of said steering column housing and said car, and said 1st end (42) of said 2nd member (40), Have the catch who permits limited movement about said pusher (28) of said 2nd member, and said steering column, It has further the Ambil device (35) with the Ambil side (35) formed so that it might collaborate with said traveling bite's each, Said Ambil side (35) is being fixed to another side of the bodies of said steering column housing, i.e., said car, A steering column

which each 1st end (32, 42) of the above and said free end are arranged mutual almost in parallel, and said traveling bite's each adjoins said 1st end before said displacement at first, and moves toward said free end during said displacement.

[Claim 28]A steering column with which said 1st member (30) and said 2nd member (40) are a nest mutually in the steering column according to claim 27.

[Claim 29]In the steering column according to claim 27, said pusher (28) has a pin (28), Said 1st member (30) had a hole (34) at said 1st end (32), and said pin (28) is prolonged through this hole, By this, fix to said pusher (28) and said 1st end (32) said catch, A steering column with which it is formed in said 2nd member (40), and a long and slender slot (44) which collaborates with said pin (28) and enables said limited movement between said pin (28) and said 2nd member (40) is formed.

[Claim 30]In the steering column according to claim 22, said 1st member (70) and said 2nd member (80) make M form, and are formed, Each of said 1st and 2nd members (70, 80), Have in the whole the two free end (72, 82) which extends in the 1st direction, and to it each of said 1st and 2nd members, Have the 2nd traveling bite and a central byte (74, 85) prolonged in said 1st direction at the whole, and said steering column, Between said central byte (74, 85) and said free end (72, 82). being positioned respectively -- and each of said traveling bite of said 1st and 2nd members (70, 80), and said 2nd traveling bite -- it having further the Ambil device (68) including one side and two Ambil sides (68) which approached, and, Said pusher (66) approaches with said central byte (74) of said 1st member (70), and is positioned, A steering column with which between said pusher (66) and said central bytes of said 2nd member (85) is separated for said catch including [as a result] a central byte (85) with said 2nd deep member (80).

[Claim 31]A steering column with which said 1st member (70) and said 2nd member (80) are a nest mutually in the steering column according to claim 30.

[Claim 32]In the steering column according to claim 30, said Ambil device (68), A steering column which has the hollow (89) formed in said steering column housing (86) and with which this hollow (89) contains a bracket (85) which can attach said pusher (66) to a body of a car including the said 1st and 2nd Ambil sides (68).

[Claim 33]In the steering column according to claim 22, said 1st member (110) and said 2nd member (120) are made and formed, and S form in this form. Each of said 1st and 2nd members (110, 120) including the 1st end (112, 122) and an opposite end (126) each aforementioned traveling bite, A steering column which adjoins said 1st end (112, 122) before said displacement, and said traveling bite is pressed by said Ambil device (96), and is moved.

[Claim 34]A steering column which is substantially parallel mutually as for said 1st end (112, 122) and said opposite end (126), and is prolonged to an opposite direction in the steering column according to claim 33.

[Claim 35]A steering column which said Ambil device (96) has at least three Ambil sides (97, 98), and is prolonged in the steering column according to claim 33 in inside of a flat surface where each of said 1st end (112, 122) and said opposite end (126) is common.
[Claim 36]A steering column with which said 1st member (110) and said 2nd member (120) are a nest mutually in the steering column according to claim 33.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to a kinetic-energy absorber style applicable to the impact-absorbing steering column of a car.
[0002]
[Description of the Prior Art]In order to make small a possibility that it is injured when an accident happens, it is common knowledge to use a kinetic energy absorber by a car. Such a device takes many various forms. When absorbing a lot of energy in comparatively small space, especially one advantageous form, It is a form which the member in which plastic deformation, such as metal wires in which plastic deformation is possible, or a strap, is possible, a pusher, and Ambil are used, and the member in which plastic deformation is possible is pulled around this Ambil, and dissipates energy at the time of modification of this member. At first, a member is bent, forms traveling bite, and positions this around Ambil. When a pusher pulls a member on Ambil, traveling bite moves the length of a strap caudad.
[0003]An example of this art is indicated to U.S. Pat. No. 5,788,278 endowed with Thomas etc. on August 4, 1998. By having touched on the patent, all the contents currently indicated by the patent should be incorporated into this specification. In this patent, metal straps are formed in the whole at M shape. The two legs of M are longer for whether your being Haruka than the web prolonged in between these legs. Each leg of M is positioned by two both sides of Ambil, and a central pusher is positioned between [of two] Ambil. The pusher is attached to the body of a car and Ambil which made the pair is attached to steering column housing in this case. At the time of a front collision, it is thought that a driver collides with a handle, compressive force is added to steering column housing by this, and Ambil is moved on both sides of a pusher. Metal straps are pulled around Ambil, when a center section is depressed between Ambil.
[0004]It was [for absorbing a lot of kinetic energy in compact space] effective to have used

the member in which plastic deformation is possible, and although it was a reliable means, in order to change the quantity of resistance appropriately according to various loads, the former was impossible for using this art. Since a car accident occurs in various severity, it is desirable to provide a little resistance in the low collision of severity, and for resistance when a comparatively serious collision takes place to provide a large energy absorption apparatus.
[0005]In order to change the quantity of resistance according to displacement of steering column housing, the trial of the conventional technology which uses the member in which plastic deformation is possible was unsuitable. This is because the chief aim is placed by that the most important design performance starts on a low power level, and shifts to a still higher level. Although the metal straps used for drawing 2 [of U.S. Pat. No. 5,375,881 endowed with Lewis on December 27, 1994] a in a way similar with having explained into the preceding sentence with reference to U.S. Pat. No. 5,778,278 of upper ** are shown, Ambil is not provided in this case. Instead, Lewis uses flexural strength and tensile strength for keeping "freedom" end from buckling by compression. In this case, tension is added to inside parts and a byte is pulled caudad actually. It is preferred to use Ambil. This has a desirable effect of friction between traveling bite and Ambil, and is for the danger of buckling to disappear by using Ambil.
[0006]The strap of Lewis's drawing 2 a has various sections. Specifically, Lewis's strap includes narrow classification near the pusher in the center, and includes double width classification toward the pars basilaris ossis occipitalis of a biped part. Since narrow classification is provided in the center, the initial resistance which increases when traveling bite reaches double width classification decreases. I hear that a strap will break and there is a problem about this design, when the big power exceeding the tensile strength of narrow classification is transmitted. Since it is greatly processed into the narrow classification of the strap by bending, the tensile strength of narrow classification is dramatically complicated. Since resistance increases by friction between Ambil and traveling bite, this danger becomes high when using Ambil.
[0007]In U.S. Pat. No. 5,026,092 endowed with Abram KUJIKKU on June 25, 1991. . Only when energy cannot be absorbed by being crushed by the bottom of control as the steering column assembly was designed no matter the main energy absorption system might be what system, came to take effect. Or only when bigger impact load than the design load of a system is added, the energy absorption steering column with a passive restricted load limited column supporting system which came to take effect is indicated. This system is designed break in an operation of a high shock, and contains the steering column bearing bracket to which a steering column can be moved up with the flexibility 2. In this case, a steering column collides with an instruments panel, carries out plastic deformation of itself and the instruments panel themselves, and provides the additional energy absorption needed by this (refer to the 5th

column of the 10th line of Abram KUJIKKU thru/or the 50th line). This system does not provide the energy absorption characteristic of a desired kind with an impact-absorbing steering column, but when the impact load beyond a specific threshold is added, the whole impact-absorbing steering column is used for it.

[0008]

[Problem(s) to be Solved by the Invention and Means for Solution]The 1st and 2nd members in which a fault of conventional technology of above-mentioned and others has traveling bite and in which plastic deformation is possible, The 1st portion of the 1st member attached to the 1st main part, and a pusher which approached, The part II material is solved by a kinetic energy absorber suitable for using it with an impact-absorbing steering column containing a catch who enables it to move only distance limited about a pusher, and the Ambil device fixed to the 2nd main part. The Ambil device approaches with traveling bite and is positioned.

Traveling bite has the Ambil side of the Ambil device, and corresponding shape.

The Ambil device presses traveling bite of the 1st member at the time of initial relative displacement between the 1st and 2nd main parts, moves along with the length of the 1st member, subsequently presses traveling bite of the 2nd member, and moves along with the length of the 2nd member.

[0009]I will be understood by referring to these explanation and accompanying drawings with other detailed features that reach.

[0010]

[Embodiment of the Invention]Drawing 1 shows the operation of the kinetic energy absorber 5 of the common knowledge which uses J strap form to an outline. The strap 10 contains the traveling bite who used looped shape on Ambil 15. The 1st end 12 of the strap 10 is pulled so that it may keep away from Ambil 15 in the direction of the arrow 14. Subsequently, the free end 16 of the strap 10 is pulled around this Ambil toward Ambil 15, and traveling bite moves the length of the strap 10 caudad.

[0011]Drawing 2 shows the partial decomposition figure of the variable resistor energy absorption apparatus 25. The pin 28 is being fixed to the 1st base material 29, and Ambil 35 is attached to the 2nd base material (not shown). Ambil 35 is a cylindrical shape in this case, and it can be supported, enabling free rotation so that it may rotate freely on that axis. The pin 28 is positioned by the hole 34 of the 1st strap 30, and the slot 44 of the 2nd strap 40. During the period for which energy absorption is needed, the pin 28 moves in the direction of the arrow 37 so that it may keep away from Ambil 35. At first, the pin 28 is forced on the 1st end 32 of the 1st strap 30, and as this explained drawing 1 into the preceding sentence, it pulls the 1st strap 30 around Ambil 35. Therefore, in this example, the pin 28 acts as a pusher. At this time, the pin 28 moves in the inside of the slot 44 formed in the 2nd strap 40, therefore the 2nd strap 40 is still stationing about Ambil 35. However, once the pin 28 reaches the opposite end of the slot

44, this will operate as a catch and will restrict the relative displacement beyond this between the 2nd strap 40 and the pin 28. The pin 28 ranks second and begins to pull the 2nd strap 40 from the 1st end 42.

[0012]Drawing 3 shows the example of the illustration of a multi-J-strap form explained into the preceding sentence about drawing 2. In this case, the color 41 is arranged around the sleeve 45 and the steering shaft (not shown) at the same mind. The color 41 is fixed to the body of a car (not shown), and the sleeve 45 is attached to steering column housing. The sleeve 45 is pressed by the left as shown in an accompanying drawing at the time of a shock, and it passes the fixed color 41 about a car. The color 41 has the pin 28 of a couple and these pins are prolonged through the hole 34 formed in each 1st strap 30. Two of the 1st straps are illustrated. The slot 44 is formed in each of the 2nd strap 40, and the pin 28 moves in accordance with these slots among the 1st portion of energy absorption movement. When the sleeve 45 moves to a left, it is forced on the traveling bite formed in the 1st strap 30, and the 1st strap 30 is bent around Ambil 35, and by this, Ambil 35 formed in the sleeve 45 generates a resistance force, and absorbs kinetic energy.

[0013]In some respects, a position contrary to the position of a graphic display within the slot 44 is reached, the pin 28 ranks second, and the pin 28 holds the 1st end 42 of the strap 40 to stationing about the color 41. when this happens, and the sleeve 45 moves to a left further, each free end of the strap 40 is pulled around this Ambil toward Ambil 35 -- this -- a resistance force -- and -- therefore, energy absorption is raised substantially.

[0014]Next, the 2nd example of this invention is described with reference to drawing 4 thru/or drawing 6. Drawing 4 shows the operation of the kinetic energy absorber 55 of the common knowledge which uses M strap form to an outline. The strap 60 contains in the circumference of each Ambil 68 two traveling bite made into looped shape. A central byte adjoins the pusher 66 and is stationed. If power is applied to the pusher 66 as the arrow 67 shows, the free end 62 of the strap 60 will be drawn in the circumference of each Ambil 68, and only the length of the free end of the strap 60 will move traveling bite. Here, Ambil 68 should note not being supported according to whether additional frictional resistance is a request, enabling free rotation, even if supported enabling free rotation.

[0015]Drawing 5 shows the schematic diagram of the variable resistor energy absorption apparatus 65 which uses M strap form. The pusher 66 is being fixed to the 1st base material (not shown), and Ambil 68 is attached to the 2nd base material (not shown). The pusher 66 moves in the direction of the arrow 67 about Ambil 68 during the period which needs energy absorption. At first, by the way, the central byte 74 pushes the 1st strap 70, and the pusher 66 is made to transform the 1st strap 70, and pulls the free end 72 around each Ambil 68. During this time, since the pusher 66 does not yet touch the 2nd strap 80, the 2nd strap 80 remains in that position. However, once the pusher 66 results in the central byte 84 of the 2nd strap 80,

the pusher 66 will begin to pull the center portion of the 2nd strap 80 in the direction which separates from Ambil 68, and will pull the free end 82 of the 2nd strap 80 around each Ambil 68. Thus, the central byte 84 who made the hollow of the pusher 66 and the 2nd strap 80 collaborates as a catch, and the central byte's 84 hollow makes possible relative displacement limited between said pusher and said central byte 84.

[0016]Drawing 6 shows the partial decomposition figure of the example of illustration of the variable resistor energy absorption apparatus which uses M strap form explained into the preceding sentence about drawing 5. It is supported by the bearing where the nest impact-absorbing steering shaft 76 is positioned in the steering column housing 86, and the front end is supported by the bearing base material 75 and which has the 2nd end in the expansion strengthening back end 87 of the steering column housing 86. The steering shaft 76 is connected with the upper shaft 78 by the universal joint 77, and the upper shaft 78 is positioned by the tilt housing 88.

[0017]The steering column housing 86 is positioned about the handle (not shown) to the bracket 85 being fixed to the body of a car (not shown). The steering column housing 86 contains the cavity 89 accommodated so that an energy absorption apparatus may be explained below. As for the cavity 89, these Ambil and 1st strap 70, and the 2nd strap 80 are a nest including Ambil 68 of a couple. The 1st end 81 is inserted through the bracket 85, and is attached to the bearing base material 75. The bracket 85 contains the central bytes 74 and 84 of the 1st and 2nd straps, and the adjusted pusher 66.

[0018]In a front collision, a driver is equivalent to a handle (not shown), the power is transmitted to the steering column housing 86, and steering column housing is ahead pressed in the direction of the arrow 91. Ambil 68 attached to the steering column housing 86 pushes the 1st and 2nd straps 70 and 80 ahead. At first, the pusher 66 of the fixed bracket 85 contacts the central byte 74 of the 1st strap 70, and pulls the 1st strap 70 around Ambil 68. then -- the pusher 66 reaching the position of the central byte 84 of the 2nd strap 80, and pulling the 2nd strap 80 around Ambil 68 subsequently in some respects, -- this -- resistance -- and -- therefore, energy absorption is raised substantially.

[0019]Next, the 3rd example is described with reference to drawing 7 thru/or drawing 10. Drawing 7 shows the operation of the kinetic energy absorber 90 of the common knowledge which uses S strap form of illustration to an outline. Although characterized by the bending form to which the 1st end 102 and the 2nd end 104 usually move S strap form together into the strap 100 in which plastic deformation is possible, and an energy absorption process, and at least two traveling bite between the 1st end and the 2nd end moves the length of a strap, This is not a necessary condition of S strap form. In the form of drawing 7, the strap 100 contains some traveling bite stationed in the Ambil device 96. The Ambil device contains the two bending surfaces 97, the center roller 98, and the stay roller 99 which were formed in the block

105. The 1st end 102 of the strap 100 is pulled in the direction which keeps away from the Ambil device 96 in the direction of the arrow 94. The free end 104 of the strap 100 is pulled toward the Ambil device 96, lengthens and distorts the strap 100 in the circumference on various surface of bending by this, and makes a lot of energy dissipate. In this example, although three traveling bite is illustrated, please note being able to use the arbitrary combination or number of flections. An example of S strap form of the common knowledge which uses only two flections is indicated by U.S. Pat. No. 5,605,352 endowed with RIFE etc. on February 25, 1997.

[0020]Drawing 8 shows the partial decomposition schematic diagram of the variable resistor energy absorption apparatus 115 which uses S strap form. The pin 28 is being fixed to the 1st base material 29, and the Ambil device 96 is being fixed to the 2nd base material (not shown). The Ambil device 96 contains two or more rollers 97, 98, and 99 in this case. During the period which needs energy absorption, the pin 28 moves so that it may keep away from the Ambil device 96 in the direction of the arrow 37. As the pin 28 is forced on the 1st end 112 of the 1st strap 110 and was explained into the preceding sentence about drawing 7 at first, the 1st strap 110 is pulled through the Ambil device 96. Therefore, the pin 28 acts as a pusher in this example. The pin 28 moves during this time in the inside of the slot 124 formed in the 2nd strap 120, therefore the 2nd strap 120 is still stationing about the Ambil device 96. However, once the pin 28 results in the opposite end of the slot 124, it will begin to pull the 2nd strap 120 from the 1st end 122. Thus, the pin 28 and the slot 124 operate as a catch who enables only limited movement between the 2nd strap 120 and the Ambil device 96. Although the 1st strap 110 is shown a little shorter than the 2nd strap 120, that may not necessarily be right. Work of the power which pulls apart the pin 28 and the Ambil device 96 in this way, It is first absorbed with the 1st strap 110, and, subsequently is absorbed with the 2nd strap 120, or is first absorbed with the 1st strap 110, and, subsequently is absorbed by both 1st and 2nd straps 110 and 120.

[0021]Drawing 9 shows the schematic diagram of the impact-absorbing steering column 130 of the illustration in the state where it assembled which provides the variable resistor energy absorption apparatus which uses S strap form explained into the preceding sentence with reference to drawing 8. The steering column 130 contains the upper steering column housing 137 accepted in the lower steering column housing 135 at the same axle. In the up-and-down steering column housing 137 and 135, the steering shafts 127 and 125 of the upper and lower sides which carry out an impact absorption to a nest within each housing are accepted at the same axle. The up-and-down steering column housing 137 and 135 is attached by the connecting part (not shown) of the halfway point which breaks easily by the way. Therefore, the connecting part which breaks easily at the time of the shock of the compressive force of sufficient strength shears, and, thereby, compressive force can be absorbed by the 1st and

2nd straps 110 and 120 shown in drawing 10. Although it has indicated that only the free end 126 of the 2nd strap 120 extends from the Ambil device 96, As explained into the preceding sentence with reference to drawing 8, the opposite end of a strap is pulled, and when resistance of the 1st quantity was produced first, it ranks second and up-and-down steering column housing breaks by this, resistance of the 2nd quantity is produced.

[0022]Although this invention was shown and explained about some examples, these examples are only illustration of this invention, and it should be understood that it is not limitation. For example, although the 1st strap of each example is shown a little shorter than the 2nd strap, it may not necessarily be so. In this way, work of a pusher and Ambil can be first absorbed with the 1st strap, subsequently can be absorbed with the 2nd strap, or is first absorbed with the 1st strap and, subsequently can be absorbed with both the 1st strap and the 2nd strap. Even when the flexural strength of the 2nd strap is larger than the 1st strap and the free end of the 1st strap passes the circumference of the Ambil device thoroughly, resistance when a pusher reaches the central byte of the 2nd strap increases substantially.

[0023]The member which carried out plastic deformation does not need to take the gestalt of the even equivalent strap of a graphic display. Other sectional shape with various circular, squares, ellipse forms, etc. can be used. It is necessary to cover the operation length of a member like a graphic display, and a cross-section area does not need to be constant. For example, drawing 7 of U.S. Pat. No. 5,788,278 (by having touched on the patent, the contents currently indicated by the patent should be incorporated into this specification), Sections decrease in number gradually toward the free end, and the metal straps of the modification which carries out the energy absorption characteristic of the member in which plastic deformation is possible as a demand by this are shown.

[0024]Although only two straps which became a nest mutually are shown, arbitrary numbers of straps are mutually made into a nest, or using the same principle, it adjoins mutually and can arrange, and an additional strap is used when the gap from an initial state increases. Although the catch who contains a pin and a slot device about the 1st and 3rd examples is shown, it replaces with this and arbitrary kinds of catch can be used.

[0025]Although the Ambil device for bending traveling bite is used for all the examples of a graphic display, although the Ambil device is preferred as written in the column of the conventional technology in this specification, it is not a required device by any means. The person skilled in the art can consider the change to the example of the statement without the Ambil device.

[0026]Therefore, these things that reach and many of other modifications are possible will be understood by the person skilled in the art, without deviating from the pneuma and the range of this invention.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a schematic diagram of the energy absorption apparatus of the conventional technology which uses J strap.
[Drawing 2]It is a schematic diagram of the variable resistor energy absorption apparatus which uses J strap form.
[Drawing 3]It is a schematic diagram of the example of illustration of the energy absorption apparatus of drawing 2.
[Drawing 4]It is a schematic diagram of the energy absorption apparatus of the conventional technology which uses M-strap.
[Drawing 5]It is a schematic diagram of the variable resistor energy absorption apparatus which uses M-strap form.
[Drawing 6]It is a schematic diagram of the example of illustration of the energy absorption apparatus of drawing 5.
[Drawing 7]It is a schematic diagram of the energy absorption apparatus of the conventional technology which uses S-strap.
[Drawing 8]It is a schematic diagram of the variable resistor energy absorption apparatus which uses S-strap.
[Drawing 9]It is a schematic diagram of the example of illustration of the energy absorption apparatus of drawing 8.
[Drawing 10]It is a figure of S-strap of the couple used in the example of drawing 9.
[Description of Notations]
5 Kinetic energy absorber
10 Strap
12 The 1st end
14 Arrow

15 Ambil
16 Free end
25 Variable resistor energy absorption apparatus
28 Pin
29 The 1st base material
30 The 1st strap
32 The 1st end
34 Hole
35 Ambil
37 Arrow
40 The 2nd strap
41 Color
42 The 1st end
44 Slot
45 Sleeve
55 Kinetic energy absorber
60 Strap
62 End
65 Variable resistor energy absorption apparatus
66 Pusher
66 and 67 Arrow
68 Ambil
70 The 1st strap
72 End
74 Central byte
75 Bearing base material
76 Steering shaft
77 Universal joint
78 Upper shaft
80 The 2nd strap
81 The 1st end
82 End
84 Central byte
85 Bracket
86 Steering column housing
87 Back end
88 Tilt housing

89 Cavity
90 A well-known kinetic energy absorber
91 and 94 Arrow
96 Ambil device
97 Two bending sides
98 Center roller
99 Stay roller
100 The strap in which plastic deformation is possible
102 The 1st end
104 The 2nd end
105 Block
110 The 1st strap
112 The 1st end
115 Variable resistor energy absorption apparatus
120 The 2nd strap
122 The 1st end
124 Slot
125 and 127 Lower steering shaft
126 End
130 The impact-absorbing steering column in the state where it assembled
135 Lower steering column housing
137 Upper steering column housing

[Translation done.]

* NOTICES *

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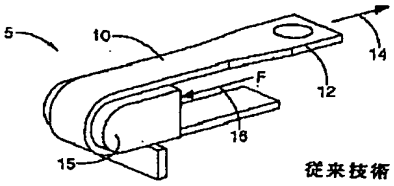
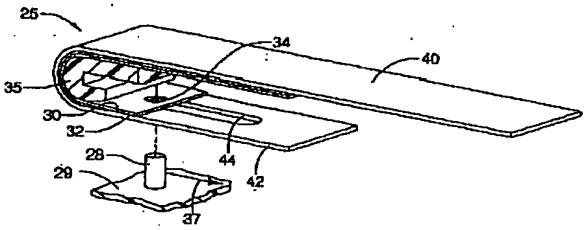
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

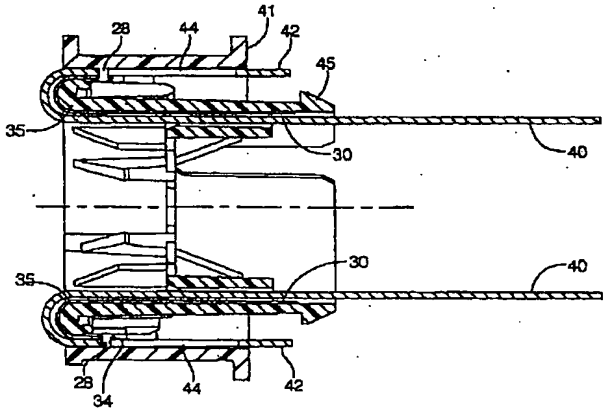
[Drawing 1]



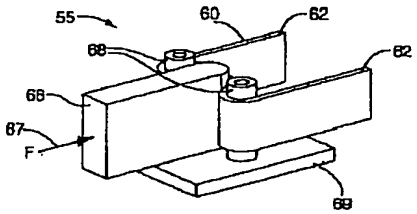
[Drawing 2]



[Drawing 3]

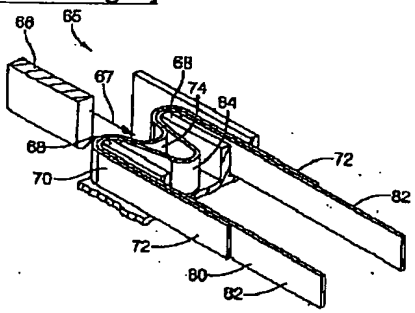


[Drawing 4]

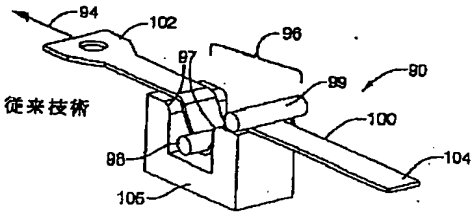


従来技術

[Drawing 5]

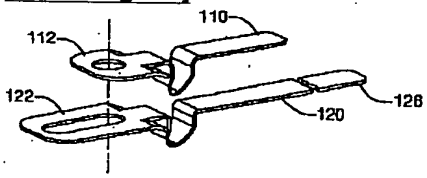


[Drawing 7]

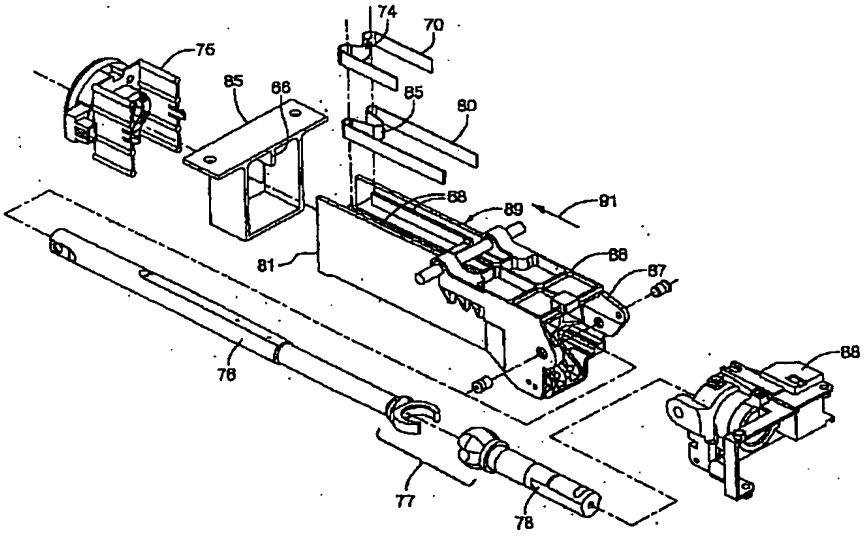


従来技術

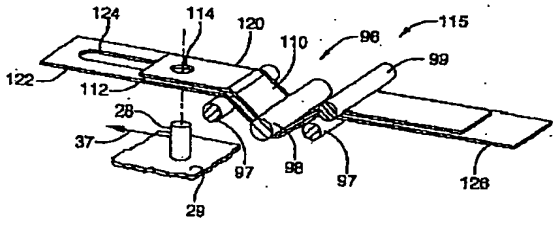
[Drawing 10]



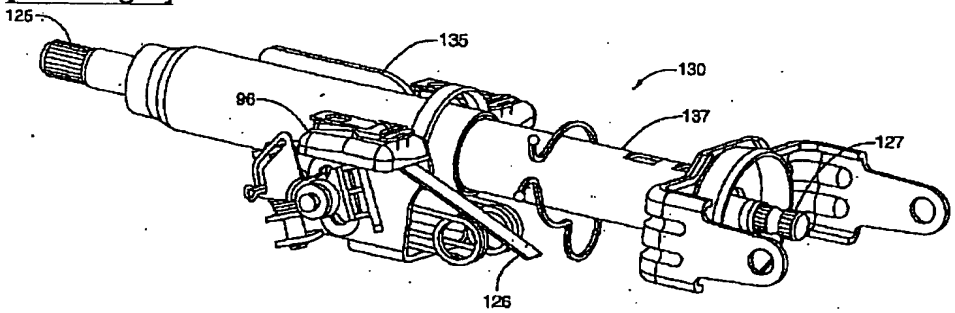
[Drawing 6]



[Drawing 8]



[Drawing 9]



[Translation done.]

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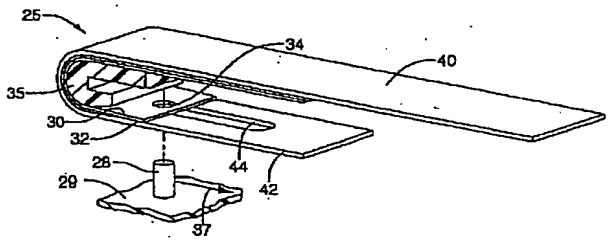
3J066 AA04 AA23 BA03 BC03 BF09 BG08

(54)【発明の名称】　運動エネルギ吸収装置

(57)【要約】
【課題】　衝撃吸収ステアリングコラムで使用するのに適した運動エネルギ吸収装置を提供する。
【解決手段】　本運動エネルギ吸収装置は、トラベリングバイトを持つ塑性変形可能な第１及び第２の部材（３０、４０）、第１部材（３０）の第１部分と近接しており、第１本体に取り付けられたプッシャ（２８）、第２部材（４０）がプッシャ（２８）に関して限定された距離だけ移動できるようにするキャッチ（４４）、及び第２本体に固定されたアンビル装置（３５）を含む。アンビル装置（３５）は、アンビル面（３５）と対応する形状を持つトラベリングバイトと近接して位置決めされている。アンビル装置は、第１及び第２の本体間の最初の相対移動時に第１部材（３０）のトラベリングバイトを押圧し、第１部材（３０）の長さに沿って移動し、次いで第２部材（４０）のトラベリングバイトを押圧し、第２部材の長さに沿って移動する。



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【特許請求の範囲】

【請求項１】　エネルギ吸収装置において、

トラベリングバイトを持つ塑性変形可能な第１部材（３０、７０、１１０）、

トラベリングバイトを持つ塑性変形可能な第２部材（４０、８０、１２０）、

第１本体（２９、４１、８５、１３５）に取り付けられており、前記第１部材（３０、７０、１１０）の第１部分と近接したプッシャ（２８、６６）、

前記第２部材（４０、８０、１２０）が前記プッシャに関して限定された距離だけ移動できるようにするキャッチであって、前記距離には限度があり、これを越えると前記第２部材（４０、８０、１２０）の第１部分が前記プッシャに効果的に固定される、キャッチ、及び第２本体（４５、８６、１３７）に固定されたアンビル装置（３５、６８、９６）であって、前記トラベリングバイトと近接して位置決めされ、前記トラベリングバイトは、前記アンビル装置（３５、６８、９６）のアンビル面と対応する形状を有するアンビル装置を有し、

前記アンビル装置（３５、６８、９６）は、前記第１及び第２の本体の最初の相対移動時に前記第１部材（３０、７０、１１０）の前記トラベリングバイトを押圧して前記第１部材（３０、７０、１１０）の長さに沿って移動させるように構成されており、前記第１及び第２の本体が相対移動を続けるとき、前記第２部材（４０、８０、１２０）の前記トラベリングバイトを前記第２部材（４０、８０、１２０）の長さに沿って移動させ、前記キャッチが前記限度に至ったとき、前記トラベリングバイトが前記第１部材（３０、７０、１１０）及び前記第２部材（４０、８０、１２０）の夫々一方を下方に移動する際に大量のエネルギを吸収し、散逸する、装置。

【請求項２】　請求項１に記載の装置において、前記第１部材（３０、７０、１１０）は、前記第２部材（４０、８０、１２０）よりもかなり短い、装置。

【請求項３】　請求項１に記載の装置において、前記第２部材（４０、８０、１２０）の断面積は、この面積が前記第１及び第２の部材の移動方向に対して垂直である場合、前記第１部材（３０、７０、１１０）よりも大きい、装置。

【請求項４】　請求項３に記載の装置において、前記第１部材（３０、７０、１１０）及び前記第２部材（４０、８０、１２０）の前記断面積は、前記第１部材（３０、７０、１１０）及び前記第２部材（４０、８０、１２０）の作動長さに亘って実質的に一定であり、前記作動長さには、前記トラベリングバイトの最初の位置で開始し前記自由端で終わる前記第１部材（３０、７０、１１０）及び前記第２部材（４０、８０、１２０）の一部が含まれる、装置。

【請求項５】　請求項１に記載の装置において、前記第１部材（３０、７０、１１０）及び前記第２部材（４０、８０、１２０）の各々は、塑性変形可能な金属ストラップを含む、装置。

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【請求項６】　請求項１に記載の装置において、前記第１及び第２の本体の一方がステアリングコラムハウジング（４５、８６、１３７）を含み、前記第１及び第２の本体の他方が車輌ボディ（４１、８５、１３５）を含む、装置。

【請求項７】　請求項１に記載の装置において、前記第１部材（３０、７０、１１０）及び前記第２部材（４０、８０、１２０）はＪ形体をなして形成されており、この形体は、各前記第１部分が前記前記第１及び第２の部材（３０、４０）の夫々一方の第１端（３２、４２）のところにあり、各前記第１及び第２の部材（３０、４０）が、前記第１端（３２、４２）と反対側の自由端を更に有し、各前記第１端（３２、４２）及び前記自由端が互いにほぼ平行に配置され、前記トラベリングバイトは、最初、前記第１及び第２の本体（２９、１３５、１３７）の前記相対移動前に前記第１端（３２、４２）と隣接しており、前記第１本体（２９、１３５）の前記第１端（３２）は前記プッシャ（２８）に固定されており、前記第２本体（１３７）の前記第１端（４２）は前記キャッチを含むことを特徴とする、装置。

【請求項８】　請求項７に記載の装置において、前記第１部材（３０）及び前記第２部材（４０）は互いに対して入れ子になっている、装置。

【請求項９】　請求項７に記載の装置において、前記第１及び第２の本体（４５、４１）の一方がステアリングコラムハウジング（４５）を含み、前記第１及び第２の本体（４５、４１）の他方が車輌ボディ（４１）を含む、装置。

【請求項１０】　請求項７に記載の装置において、前記アンビル装置（３５）はスリーブ（４５）を含み、このスリーブ（４５）はステアリングシャフトを中心として位置決めでき、前記第１本体（４１）は、前記スリーブ（４５）を中心として同心に配置できるカラー（４１）を含み、前記第１及び第２の部材の各々の前記自由端は前記スリーブ（４５）及び前記カラー（４１）の軸線に沿って延びている、装置。

【請求項１１】　請求項１０に記載の装置において、前記第１及び第２の部材（３０、４０）から約１８０°で配置された第２第１部材（３０）及び第２第２部材（４０）を更に含む、装置。

【請求項１２】　請求項７に記載の装置において、前記プッシャ（２８）はピン（２８）を含み、前記第１部材（３０）は前記第１端（３２）に穴（３４）を有し、この穴を通って前記ピン（２８）が延び、これによって前記第１端（３２）を前記プッシャ（２８）に固定し、前記キャッチは、前記第２部材（４０）に形成された細長いスロット（４４）を有し、このスロットは前記ピン（２８）と協働し、前記ピン（２８）と前記第２部材

（４０）との間の前記限定された移動を可能にする、装置。

【請求項１３】　請求項１に記載の装置において、前記第１部材（３０、７０、１１０）及び前記第２部材（４０、８０、１２０）はM形体をなして形成されており、前記第１及び第２の部材（７０、８０）の各々は　全体に第１方向に延びる二つの自由端（７２、８２）、第２トラベリングバイト、及び全体に前記第１方向に延びる中央バイト（７４、８５）を有し、前記アンビル装置（６８）は、前記中央バイト（７４、８５）と前記自由端（７２、８２）との間に前記第１及び第２の部材（７０、８０）の前記トラベリングバイト及び前記第２トラベリングバイトと近接して各々位置決めされた二つのアンビル面（６８）を有し、前記プッシャ（６６）は前記第１部材（７０）の前記中央バイト（７２）と近接して位置決めされており、前記キャッチは、前記プッシャ（６６）と前記第２部材（８０）の前記中央バイト（８５）との間が離間されている、装置。

【請求項１４】　請求項１３に記載の装置において、前記第１部材（７０）及び前記第２部材（８０）は互いに入れ子になっている、装置。

【請求項１５】　請求項１３に記載の装置において、前記第１及び第２の本体の一方がステアリングコラムハウジング（８６）を含み、前記第１及び第２の本体の他方が車輌ボディ（８５）を含む、装置。

【請求項１６】　請求項１３に記載の装置において、前記アンビル装置（６８）は、ステアリングコラムハウジング（８６）に形成された凹所（８９）を含み、この凹所（８９）は前記第１及び第２のアンビル面（６８）を含み、前記プッシャ（６６）は、車輌のボディに取り付けることができるブラケット（８５）を含む、装置。

【請求項１７】　請求項１に記載の装置において、前記第１部材（１１０）及び前記第２部材（１２０）は、S形体をなして形成されており、この形体は、各前記第１部分が前記第１及び第２の部材（１１０、１２０）の夫々一方の第１端（１１２、１２２）にあり、各前記第１及び第２の部材（１１０、１２０）は、反対端（１２６）を更に有し、前記トラベリングバイトは、前記第１及び第２の本体（２９、１３５、１３７）の前記相対移動前に前記第１端（１１２、１２２）と隣接していることを特徴とする、装置。

【請求項１８】　請求項１７に記載の装置において、各前記第１端（１１２、１２２）及び前記反対端（１２６）は互いに対してほぼ平行であり、両方向に延びている、装置。

【請求項１９】　請求項１８に記載の装置において、前記アンビル装置（９６）は少なくとも三つのアンビル面（９７、９８）を含み、各前記第１端及び前記反対端は共通の平面内を延びている、装置。

【請求項２０】　請求項１７に記載の装置において、前記第１部材（１１０）及び前記第２部材（１２０）は互いに入れ子になっている、装置。

【請求項２１】　請求項１７に記載の装置において、前記第１及び第２の本体（２９、１３５、１３７）の一つがステアリングコラムハウジング（１３７）を含み、前記第１及び第２の本体の他方が車輌ボディ（１３５）を含む、装置。

【請求項２２】　運動エネルギ吸収用衝撃吸収ステアリングコラムにおいて、前記衝撃吸収ステアリングコラム（７６、１３０）に作用する圧縮力に抵抗することによって運動エネルギを吸収するエネルギ吸収装置を含み、このエネルギ吸収装置は、ステアリングコラムハウジング（４５、８６、１３７）、塑性変形可能な第１部材（３０、７０、１１０）、及び塑性変形可能な第２部材（４０、８０、１２０）を含み、前記圧縮力は、前記ステアリングコラムハウジング（４５、８６、１３７）に及ぼされ、前記ステアリングコラムハウジング（４５、８６、１３７）を変位させ、最初、前記第２部材（４０、８０、１２０）でなく前記第１部材（３０、７０、１１０）を通して差し向けられ、幾つかの予め画成された点で、その後、前記変位中、前記圧縮力が前記第２部材（４０、８０、１２０）を通過し、前記第１及び第２の部材（３０、４０、７０、８０、１１０、１２０）の各々はトラベリングバイトを含み、前記部材（３０、４０、７０、８０、１１０、１２０）は、前記トラベリングバイトを押圧して前記部材（３０、４０、７０、８０、１１０、１２０）の所定の長さだけ移動させることによって前記運動エネルギを吸収する、ステアリングコラム。

【請求項２３】　請求項２２に記載のステアリングコラムにおいて、前記第１部材（３０、７０、１１０）は前記第２部材（４０、８０、１２０）よりもかなり短い、ステアリングコラム。

【請求項２４】　請求項２２に記載のステアリングコラムにおいて、前記第２部材（４０、８０、１２０）の断面積は、前記第１部材（３０、７０、１１０）よりも大きい、ステアリングコラム。

【請求項２５】　請求項２４に記載のステアリングコラムにおいて、前記第１部材（３０、７０、１１０）及び前記第２部材（４０、８０、１２０）の前記断面積は、前記第１及び第２の部材（３０、４０、７０、８０、１１０、１２０）の作動長さに亘って実質的に一定であり、前記作動長さには、前記トラベリングバイトの最初の位置で開始し前記自由端で終わる前記第１及び第２の部材（３０、４０、７０、８０、１１０、１２０）の一部が含まれる、ステアリングコラム。

【請求項２６】　請求項２２に記載のステアリングコラムにおいて、前記第１部材（３０、７０、１１０）及び前記第２部材（４０、８０、１２０）の各々は、塑性変形可能な金属ストラップを含む、ステアリングコラム。

【請求項２７】　請求項２２に記載のステアリングコラムにおいて、前記第１部材（３０）及び前記第２部材（４０）はＪ形体をなして形成されており、前記第１及び第２の部材（３０、４０）の各々は、第１端（３２、４２）及びこの第１端（３２、４２）の反対側の自由端を有し、前記第１部材（３０）の前記第１端は、前記ステアリングコラムハウジング及び前記車輌のボディのうちの一方に固定されたプッシャ（２８）に固定されており、前記第２部材（４０）の前記第１端（４２）は、前記第２部材の前記プッシャ（２８）に関する限定された移動を許容するキャッチを有し、前記ステアリングコラムは、前記トラベリングバイトの各々と協働するように形成されたアンビル面（３５）を持つアンビル装置（３５）を更に有し、前記アンビル面（３５）は前記ステアリングコラムハウジング即ち前記車輌のボディのうちの他方に固定されており、
各前記第１端（３２、４２）及び前記自由端は互いにほぼ平行に配置されており、前記トラベリングバイトの各々は、最初、前記変位前に前記第１端と隣接しており、前記変位中、前記自由端に向かって移動する、ステアリングコラム。
【請求項２８】　請求項２７に記載のステアリングコラムにおいて、前記第１部材（３０）及び前記第２部材（４０）は互いに入れ子になっている、ステアリングコラム。
【請求項２９】　請求項２７に記載のステアリングコラムにおいて、前記プッシャ（２８）はピン（２８）を有し、前記第１部材（３０）は前記第１端（３２）に穴（３４）を有し、この穴を通って前記ピン（２８）が延びており、これによって前記第１端（３２）を前記プッシャ（２８）に固定し、前記キャッチは、前記第２部材（４０）に形成され、前記ピン（２８）と協働して前記ピン（２８）と前記第２部材（４０）との間の前記限定された移動を可能にする細長いスロット（４４）が形成されている、ステアリングコラム。
【請求項３０】　請求項２２に記載のステアリングコラムにおいて、前記第１部材（７０）及び前記第２部材（８０）はM形体をなして形成されており、前記第１及び第２の部材（７０、８０）の各々は、全体に第１方向に延びる二つの自由端（７２、８２）を有し、前記第１及び第２の部材の各々は、第２トラベリングバイト、及び全体に前記第１方向に延びる中央バイト（７４、８５）を有し、前記ステアリングコラムは、前記中央バイト（７４、８５）と前記自由端（７２、８２）との間に各々位置決めされており且つ前記第１及び第２の部材（７０、８０）の前記トラベリングバイト及び前記第２トラベリングバイトの夫々一方と近接した二つのアンビル面（６８）を含むアンビル装置（６８）を更に有し、前記プッシャ（６６）は前記第１部材（７０）の前記中央バイト（７４）と近接して位置決めされており、前記

キャッチは前記第２部材（８０）の深い中央バイト（８５）を含み、その結果、前記プッシャ（６６）と前記第２部材（８５）の前記中央バイトとの間が分離される、ステアリングコラム。
【請求項３１】　請求項３０に記載のステアリングコラムにおいて、前記第１部材（７０）及び前記第２部材（８０）は互いに入れ子になっている、ステアリングコラム。
【請求項３２】　請求項３０に記載のステアリングコラムにおいて、前記アンビル装置（６８）は、前記ステアリングコラムハウジング（８６）に形成された凹所（８９）を有し、この凹所（８９）は前記第１及び第２のアンビル面（６８）を含み、前記プッシャ（６６）は車輌のボディに取り付けることができるブラケット（８５）を含む、ステアリングコラム。
【請求項３３】　請求項２２に記載のステアリングコラムにおいて、前記第１部材（１１０）及び前記第２部材（１２０）はＳ形体をなして形成されており、この形体では、前記第１及び第２の部材（１１０、１２０）の各々が第１端（１１２、１２２）及び反対端（１２６）を含み、各前記トラベリングバイトは、前記変位前には前記第１端（１１２、１２２）と隣接しており、前記トラベリングバイトは前記アンビル装置（９６）によって押圧されて移動される、ステアリングコラム。
【請求項３４】　請求項３３に記載のステアリングコラムにおいて、前記第１端（１１２、１２２）及び前記反対端（１２６）は互いに実質的に平行であり、逆方向に延びる、ステアリングコラム。
【請求項３５】　請求項３３に記載のステアリングコラムにおいて、前記アンビル装置（９６）は少なくとも三つのアンビル面（９７、９８）を有し、前記第１端（１１２、１２２）及び前記反対端（１２６）の各々は共通の平面内を延びる、ステアリングコラム。
【請求項３６】　請求項３３に記載のステアリングコラムにおいて、前記第１部材（１１０）及び前記第２部材（１２０）は互いに入れ子になっている、ステアリングコラム。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、車輌の衝撃吸収ステアリングコラムに適用できる運動エネルギ吸収機構に関する。
【０００２】
【従来の技術】事故が起こった場合に怪我をする可能性を小さくするため、運動エネルギ吸収装置を車輌で使用することが周知である。このような装置は、多くの様々な形体をとる。比較的小さな空間で大量のエネルギを吸収する上で特に有利な一つの形体は、塑性変形可能な金属製ワイヤ又はストラップ等の塑性変形可能な部材、プッシャ、及びアンビルを使用し、このアンビルの周囲で

塑性変形可能な部材が引っ張られ、この部材の変形時にエネルギを散逸する形体である。部材は、最初、曲げられてトラベリングバイトを形成し、これをアンビルの周囲に位置決めする。プッシャが部材をアンビル上で引っ張るとき、トラベリングバイトはストラップの長さを下方に移動する。

【０００３】この技術の一例が１９９８年８月４日にトーマス等に賦与された米国特許第５，７８８，２７８号に記載されている。同特許に触れたことにより、その特許に開示されている内容は全て本明細書中に組入れたものとする。この特許では、金属ストラップを全体にM形状に形成する。Mの二つの脚部は、これらの脚部間を延びるウェブよりも遙かに長い。Mの各脚部は二つのアンビルの両側に位置決めされており、中央プッシャが二つのアンビル間に位置決めされる。プッシャは車輛のボディに取り付けられており、この際、対をなしたアンビルはステアリングコラムハウジングに取り付けられている。前方衝突時には、運転者がハンドルにぶつかると考えられ、これによりステアリングコラムハウジングに圧縮力が加わり、アンビルをプッシャの両側で移動させる。金属ストラップは、中央部がアンビルの間で押し下げられるとき、アンビルの周囲で引っ張られる。

【０００４】塑性変形可能な部材を使用することは、大量の運動エネルギをコンパクトな空間で吸収するための効果的で且つ信頼性がある手段であるけれども、抵抗の量を様々な負荷に応じて適切に変化させるためにこの技術を使用することはこれまで不可能であった。車輛事故は様々な重大度で発生するため、重大度の低い衝突の場合に少量の抵抗を提供し、比較的重大な衝突が起こった場合の抵抗が大きいエネルギ吸収装置を提供するのが望ましい。

【０００５】ステアリングコラムハウジングの変位に従って抵抗の量を変化させるために塑性変形可能な部材を使用する従来技術の試みは不適切であった。これは、最も重要な設計性能が、低い力レベルで始まって更に高いレベルに移行することに主眼が置かれているためである。１９９４年１２月２７日にルイスに賦与された米国特許第５，３７５，８８１号の図２ａには、上掲の米国特許第５，７７８，２７８号を参照して上文中に説明したのと同様の方法で使用される金属ストラップが示されているが、この場合にはアンビルが設けられていない。その代わりに、ルイスは、「自由」端が圧縮により座屈しないようにするのに曲げ強度及び引張強度を使用する。この場合、内側の部品に張力が加わっており、実際にはバイトを下方に引っ張る。アンビルを使用するのが好ましい。これは、トラベリングバイトとアンビルとの間の摩擦の効果が望ましく、アンビルを使用することにより座屈の危険がなくなるためである。

【０００６】ルイスの図２ａのストラップは、様々な断面を有する。特定的には、ルイスのストラップは狭幅区分を中央に、プッシャの近傍に含み、広幅区分を両脚部の底部に向かって含む。中央に狭幅区分が設けられているため、トラベリングバイトが広幅区分に到達したときに増大する初期抵抗が減少する。この設計に関する問題点は、狭幅区分の引張強度を越える大きな力が伝達されるとストラップが壊れてしまうということである。ストラップの狭幅区分には曲げにより大きく加工されているため、狭幅区分の引張強度は非常に複雑である。アンビルとトラベリングバイトとの間の摩擦により抵抗が増大するため、アンビルを使用する場合にこの危険が高くなる。

【０００７】１９９１年６月２５日にアブラムクジックに賦与された米国特許第５，０２６，０９２号には、主エネルギ吸収システムが、どのようなシステムであっても、ステアリングコラムアッセンブリが設計された通りに制御下で潰れることによってエネルギを吸収することができない場合にだけ効果を示すようになった、又はシステムの設計荷重よりも大きな衝撃荷重が加わった場合にだけ効果を示すようになった、受動的拘束負荷限定コラム支持システムを持つエネルギ吸収ステアリングコラムが記載されている。このシステムは、高い衝撃の作用で壊れるように設計され、ステアリングコラムを自由度２で上方に移動させることができるステアリングコラム支持ブラケットを含む。この場合、ステアリングコラムは計器パネルに衝突し、それ自体及び計器パネル自体を塑性変形させ、これによって、必要とされる追加のエネルギ吸収を提供する（アブラムクジックの第５コラム第１０行目乃至第５０行目参照）。このシステムは、衝撃吸収ステアリングコラムで所望の種類のエネルギ吸収特性を提供せず、特定の閾値以上の衝撃荷重が加わった場合に衝撃吸収ステアリングコラム全体を使用する。

【０００８】

【発明が解決しようとする課題及び課題を解決するための手段】上述の及び他の従来技術の欠点は、トラベリングバイトを持つ塑性変形可能な第１及び第２の部材、第１本体に取り付けられた第１部材の第１部分と近接したプッシャ、第２部材がプッシャに関して限定された距離だけ移動できるようにするキャッチ、及び第２本体に固定されたアンビル装置を含む衝撃吸収ステアリングコラムで使用するのに適した運動エネルギ吸収装置によって解決される。アンビル装置は、トラベリングバイトと近接して位置決めされており、トラベリングバイトはアンビル装置のアンビル面と対応する形状を持つ。アンビル装置は、第１及び第２の本体間の初期相対移動時に第１部材のトラベリングバイトを押圧し、第１部材の長さに沿って移動し、次いで第２部材のトラベリングバイトを押圧し、第２部材の長さに沿って移動する。

【０００９】これらの及び他の特徴は、詳細な説明及び添付図面を参照することにより理解されるであろう。

【００１０】

【発明の実施の形態】図１は、Ｊストラップ形体を使用する周知の運動エネルギ吸収装置５の作動を概略に示す。ストラップ１０はアンビル１５上でループ状にしたトラベリングバイトを含む。ストラップ１０の第１端１２は、矢印１４の方向にアンビル１５から遠ざかるように引っ張られる。次いで、ストラップ１０の自由端１６をアンビル１５に向かって及びこのアンビルの周囲に引っ張り、トラベリングバイトが、ストラップ１０の長さを下方に移動するようにする。

【００１１】図２は、可変抵抗エネルギ吸収装置２５の部分分解図を示す。ピン２８が第１支持体２９に固定されており、アンビル３５が第２支持体（図示せず）に取り付けられている。アンビル３５は、この場合には円筒形であり、その軸線上で自由に回転するように回転自在に支持できる。ピン２８は第１ストラップ３０の穴３４及び第２ストラップ４０のスロット４４に位置決めされている。エネルギ吸収が必要とされる期間中、ピン２８はアンビル３５から遠ざかるように矢印３７の方向に移動する。最初、ピン２８は第１ストラップ３０の第１端３２に押し付けられ、これにより図１に関して上文中に説明したように、第１ストラップ３０をアンビル３５の周囲に引っ張る。従って、この実施例では、ピン２８はプッシャとして作用する。このとき、ピン２８は第２ストラップ４０に形成されたスロット４４内を移動し、そのため、第２ストラップ４０はアンビル３５に関して定置のままである。しかしながら、ひとたびピン２８がスロット４４の反対端に達すると、これがキャッチとして作動し、第２ストラップ４０とピン２８との間のこれ以上の相対移動を制限する。ピン２８は、次いで、第２ストラップ４０をその第１端４２から引っ張り始める。

【００１２】図３は、図２に関して上文中に説明した多Ｊーストラップ形体の例示の実施例を示す。この場合、カラー４１がスリーブ４５及びステアリングシャフト（図示せず）の周囲に同心に配置されている。カラー４１は車輌（図示せず）のボディに固定され、スリーブ４５はステアリングコラムハウジングに取り付けられている。スリーブ４５は、衝撃時に添付図面に示すように左方に押圧され、車輌に関して定置のカラー４１を通過する。カラー４１は一対のピン２８を有し、これらのピンは、夫々の第１ストラップ３０に形成された穴３４を通って延びる。第１ストラップの２つが図示してある。第２ストラップ４０の夫々にはスロット４４が設けられており、エネルギ吸収移動の第１部分中、これらのスロットに沿ってピン２８が移動する。スリーブ４５が左方に移動するとき、スリーブ４５内に形成されたアンビル３５が第１ストラップ３０に形成されたトラベリングバイトに押し付けられ、第１ストラップ３０をアンビル３５の周囲で曲げ、これによって抵抗力を発生し、運動エネルギを吸収する。

【００１３】幾つかの点で、ピン２８はスロット４４内

で図示の位置とは逆の位置に達し、ピン２８は、次いで、ストラップ４０の第１端４２をカラー４１に関して定置に保持する。これが起こったとき、スリーブ４５が更に左方に移動することにより、ストラップ４０の夫々の自由端がアンビル３５に向かってこのアンビルの周囲に引っ張られ、これによって抵抗力及び従ってエネルギ吸収を大幅に高める。

【００１４】次に、本発明の第２実施例を図４乃至図６を参照して説明する。図４は、Ｍストラップ形体を使用する周知の運動エネルギ吸収装置５５の作動を概略に示す。ストラップ６０は、各アンビル６８の周囲にループ状にされた二つのトラベリングバイトを含む。中央バイトがプッシャ６６と隣接して配置されている。プッシャ６６に力を矢印６７で示すように加えると、ストラップ６０の自由端６２が夫々のアンビル６８の周囲に引き込まれ、トラベリングバイトをストラップ６０の自由端の長さだけ移動させる。ここで、アンビル６８は、追加の摩擦抵抗が所望であるかどうかに応じて、回転自在に支持されていても回転自在に支持されていなくてもよいということに着目されたい。

【００１５】図５は、Ｍストラップ形体を使用する可変抵抗エネルギ吸収装置６５の概略図を示す。プッシャ６６は第１支持体（図示せず）に固定されており、アンビル６８は第２支持体（図示せず）に取り付けられている。エネルギ吸収を必要とする期間中、プッシャ６６はアンビル６８に関して矢印６７の方向に移動する。最初、プッシャ６６が第１ストラップ７０を中央バイト７４のところで押し、第１ストラップ７０を変形させ、自由端７２を夫々のアンビル６８の周囲で引っ張る。この時間中、プッシャ６６が未だ第２ストラップ８０と接触していないため、第２ストラップ８０はその位置にとどまる。しかしながら、ひとたびプッシャ６６が第２ストラップ８０の中央バイト８４に至ると、プッシャ６６は第２ストラップ８０の中央部分をアンビル６８から離れる方向へ引っ張り始め、第２ストラップ８０の自由端８２を各アンビル６８の周囲で引っ張る。このようにして、プッシャ６６及び第２ストラップ８０の凹所をなした中央バイト８４はキャッチとして協働し、中央バイト８４の凹所が前記プッシャと前記中央バイト８４との間で限定された相対移動を可能にする。

【００１６】図６は、図５に関して上文中に説明したＭストラップ形体を使用する可変抵抗エネルギ吸収装置の例示の実施例の部分分解図を示す。入れ子衝撃吸収ステアリングシャフト７６がステアリングコラムハウジング８６内に位置決めされており、前端がベアリング支持体７５によって支持されており、第２端がステアリングコラムハウジング８６の拡大強化後端８７にあるベアリングによって支持されている。ステアリングシャフト７６はユニバーサルジョイント７７によって上シャフト７８に連結されており、上シャフト７８はチルトハウジング

８８に位置決めされている。

【００１７】ブラケット８５が車輌（図示せず）のボディに固定されているのに対し、ステアリングコラムハウジング８６はハンドル（図示せず）に関して位置決めされている。ステアリングコラムハウジング８６は、エネルギ吸収装置を以下に説明するように収容するキャビティ８９を含む。キャビティ８９は一対のアンビル６８を含み、これらのアンビルと第１ストラップ７０及び第２ストラップ８０とが入れ子になっている。第１端８１は、ブラケット８５を通して挿入され、ベアリング支持体７５に取り付けられる。ブラケット８５は、第１及び第２のストラップの中央バイト７４及び８４と整合したプッシャ６６を含む。

【００１８】前方衝突の場合、運転者がハンドル（図示せず）に当り、その力がステアリングコラムハウジング８６に伝達され、ステアリングコラムハウジングが矢印９１の方向で前方に押圧される。ステアリングコラムハウジング８６に取り付けられたアンビル６８が第１及び第２のストラップ７０及び８０を前方に押す。定置のブラケット８５のプッシャ６６は、最初、第１ストラップ７０の中央バイト７４と接触し、第１ストラップ７０をアンビル６８の周囲で引っ張る。その後、幾つかの点で、プッシャ６６が第２ストラップ８０の中央バイト８４の位置に達し、次いで第２ストラップ８０をアンビル６８の周囲で引っ張り、これによって抵抗及び従ってエネルギ吸収を大幅に高める。

【００１９】次に、第３実施例を図７乃至図１０を参照して説明する。図７は、例示のＳストラップ形体を使用する周知の運動エネルギ吸収装置９０の作動を概略に示す。Ｓストラップ形体は、通常は、塑性変形可能なストラップ１００、及びエネルギ吸収プロセス中に第１端１０２及び第２端１０４が一緒に移動し、第１端と第２端との間の少なくとも二つのトラベリングバイトがストラップの長さを移動する曲げ形体を特徴とするが、これは、Ｓストラップ形体の必要条件ではない。図７の形体では、ストラップ１００は、アンビル装置９６内に配置された幾つかのトラベリングバイトを含む。アンビル装置は、ブロック１０５に形成された二つの曲げ表面９７、中央ローラ９８、及びステイローラ９９を含む。ストラップ１００の第１端１０２は矢印９４の方向にアンビル装置９６から遠ざかる方向に引っ張られる。ストラップ１００の自由端１０４は、アンビル装置９６に向かって引っ張られ、これによりストラップ１００を様々な曲げ表面の周囲で引き歪め、大量のエネルギを散逸させる。この例では、三つのトラベリングバイトが図示してあるけれども、屈曲部の任意の組み合わせ又は数を使用できるということに着目されたい。二つの屈曲部だけを使用する周知のＳストラップ形体の一例が１９９７年２月２５日にリーフェ等に賦与された米国特許第５，６０５，３５２号に開示されている。

【００２０】図８は、Ｓストラップ形体を使用する可変抵抗エネルギ吸収装置１１５の部分分解概略図を示す。ピン２８が第１支持体２９に固定されており、アンビル装置９６が第２支持体（図示せず）に固定されている。アンビル装置９６は、この場合、複数のローラ９７、９８、及び９９を含む。エネルギ吸収を必要とする期間中、ピン２８は、矢印３７の方向にアンビル装置９６から遠ざかるように移動する。最初、ピン２８を第１ストラップ１１０の第１端１１２に押し付け、図７に関して上文中に説明したように、第１ストラップ１１０をアンビル装置９６を通して引っ張る。従って、ピン２８は、この実施例では、プッシャとして作用する。この時間中、ピン２８は第２ストラップ１２０に形成されたスロット１２４内を移動し、従って、第２ストラップ１２０はアンビル装置９６に関して定置のままである。しかしながら、ピン２８は、ひとたびスロット１２４の反対端に至ると、第２ストラップ１２０をその第１端１２２から引っ張り始める。このようにして、ピン２８及びスロット１２４は、第２ストラップ１２０とアンビル装置９６との間の限定された移動だけを可能にするキャッチとして作動する。第１ストラップ１１０が第２ストラップ１２０よりも幾分短く示してあるけれども、必ずしもそうでなくてもよい。かくして、ピン２８とアンビル装置９６とを引き離す力の仕事は、最初に第１ストラップ１１０によって吸収され、次いで第２ストラップ１２０によって吸収されるか或いは、最初に第１ストラップ１１０によって吸収され、次いで第１及び第２ストラップ１１０、１２０の両方によって吸収される。

【００２１】図９は、図８を参照して上文中に説明したＳストラップ形体を使用する可変抵抗エネルギ吸収装置を提供する組み立てた状態の例示の衝撃吸収ステアリングコラム１３０の概略図を示す。ステアリングコラム１３０は、下ステアリングコラムハウジング１３５に同軸に受け入れられた上ステアリングコラムハウジング１３７を含む。上下のステアリングコラムハウジング１３７、１３５内には、夫々のハウジング内で入れ子に衝撃吸収する上下のステアリングシャフト１２７、１２５が同軸に受け入れられている。上下のステアリングコラムハウジング１３７、１３５は、中間点のところで壊れ易い連結部（図示せず）によって取り付けられている。そのため、十分な強さの圧縮力の衝撃時に壊れ易い連結部が剪断し、これにより圧縮力を、図１０に示した第１及び第２のストラップ１１０、１２０で吸収できる。第２ストラップ１２０の自由端１２６だけがアンビル装置９６から延びるように示してあるが、図８を参照して上文中に説明したようにストラップの反対端が引っ張られ、これによって、最初に第１量の抵抗を生じ、次いで、上下のステアリングコラムハウジングが壊れたときに第２量の抵抗を生じる。

【００２２】本発明を幾つかの実施例に関して示し且つ

説明したけれども、これらの実施例は単に本発明の例示であって限定ではないということは理解されるべきである。例えば、各実施例の第１ストラップは第２ストラップよりも幾分短く示してあるけれども、必ずしもそうでなくてもよい。かくして、プッシャ及びアンビルの仕事は、最初に第１ストラップによって吸収でき、次いで第２ストラップによって吸収でき、又は最初に第１ストラップによって吸収し、次いで第１ストラップ及び第２ストラップの両方によって吸収できる。第２ストラップの曲げ強度が第１ストラップよりも大きい場合、第１ストラップの自由端がアンビル装置の周囲を完全に通過した場合でも、プッシャが第２ストラップの中央バイトに到達したときの抵抗が大幅に増大する。

【００２３】更に、塑性変形した部材は、図示の平らな均等なストラップの形態をとる必要はない。円形、正方形、楕円形、等の様々な他の断面形状を使用できる。更に、図示のように部材の作動的長さに亘って断面積が一定である必要はない。例えば、米国特許第５，７８８，２７８号（同特許に触れたことにより、その特許に開示されている内容は本明細書中に組入れたものとする）の図７は、断面が自由端に向かって徐々に減少し、これによって塑性変形可能な部材のエネルギ吸収特性を要求通りにする変形例の金属ストラップを示す。

【００２４】更に、互いに入れ子になった二つのストラップだけが示してあるけれども、任意の数のストラップを互いに入れ子にでき、又は同じ原理を使用して互いに隣接して配置でき、初期状態からのずれが増大したときに追加のストラップが利用される。更に、第１及び第３の実施例についてピン及びスロット装置を含むキャッチが示してあるけれども、これに代えて任意の種類のキャッチを使用できる。

【００２５】更に、図示の全ての実施例は、トラベリングバイトを曲げるためのアンビル装置を使用するが、アンビル装置は、本明細書中の従来技術の欄に記載してあるように、好ましいけれども絶対に必要な装置ではない。当業者は、アンビル装置なしの記載の実施例に対する変更を考えることができる。

【００２６】従って、本発明の精神及び範囲から逸脱することなく、これらの及び多くの他の変形例が可能であるということは当業者には理解されよう。

【図面の簡単な説明】

【図１】Ｊストラップを使用する従来技術のエネルギ吸収装置の概略図である。

【図２】Ｊストラップ形体を使用する可変抵抗エネルギ吸収装置の概略図である。

【図３】図２のエネルギ吸収装置の例示の実施例の概略図である。

【図４】Ｍーストラップを使用する従来技術のエネルギ吸収装置の概略図である。

【図５】Ｍーストラップ形体を使用する可変抵抗エネルギ吸収装置の概略図である。

【図６】図５のエネルギ吸収装置の例示の実施例の概略図である。

【図７】Ｓーストラップを使用する従来技術のエネルギ吸収装置の概略図である。

【図８】Ｓーストラップを使用する可変抵抗エネルギ吸収装置の概略図である。

【図９】図８のエネルギ吸収装置の例示の実施例の概略図である。

【図１０】図９の実施例で使用された一対のＳーストラップの図である。

【符号の説明】

５　運動エネルギ吸収装置
１０　ストラップ
１２　第１端
１４　矢印
１５　アンビル
１６　自由端
２５　可変抵抗エネルギ吸収装置
２８　ピン
２９　第１支持体
３０　第１ストラップ
３２　第１端
３４　穴
３５　アンビル
３７　矢印
４０　第２ストラップ
４１　カラー
４２　第１端
４４　スロット
４５　スリーブ
５５　運動エネルギ吸収装置
６０　ストラップ
６２　端
６５　可変抵抗エネルギ吸収装置
６６　プッシャ
６６、６７　矢印
６８　アンビル
７０　第１ストラップ
７２　端
７４　中央バイト
７５　ベアリング支持体
７６　ステアリングシャフト
７７　ユニバーサルジョイント
７８　上シャフト
８０　第２ストラップ
８１　第１端
８２　端
８４　中央バイト
８５　ブラケット

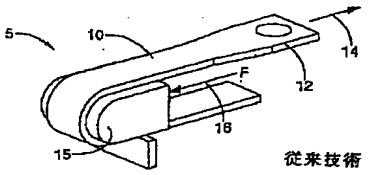
15

８６　ステアリングコラムハウジング
８７　後端
８８　チルトハウジング
８９　キャビティ
９０　周知の運動エネルギ吸収装置
９１、９４　矢印
９６　アンビル装置
９７　二つの曲げ面
９８　中央ローラ
９９　ステーローラ
１００　塑性変形可能なストラップ
１０２　第１端
１０４　第２端

16

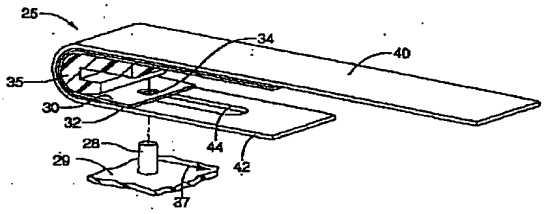
１０５　ブロック
１１０　第１ストラップ
１１２　第１端
１１５　可変抵抗エネルギ吸収装置
１２０　第２ストラップ
１２２　第１端
１２４　スロット
１２５、１２７　下ステアリングシャフト
１２６　端部
１３０　組み立てた状態の衝撃吸収ステアリングコラム
１３５　下ステアリングコラムハウジング
１３７　上ステアリングコラムハウジング

【図１】



従来技術

【図２】



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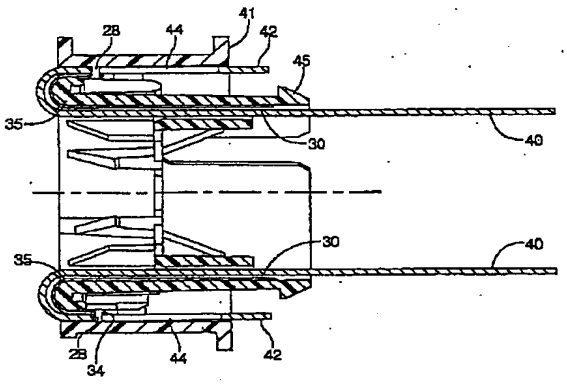

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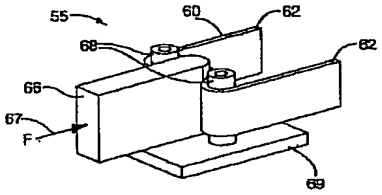
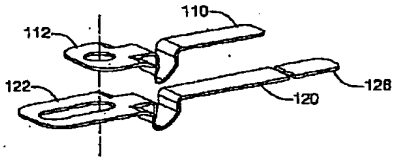
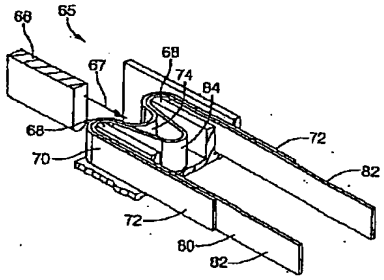


従来技術

【図１０】



【図５】



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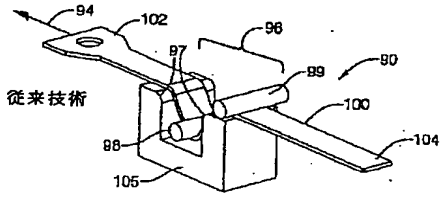
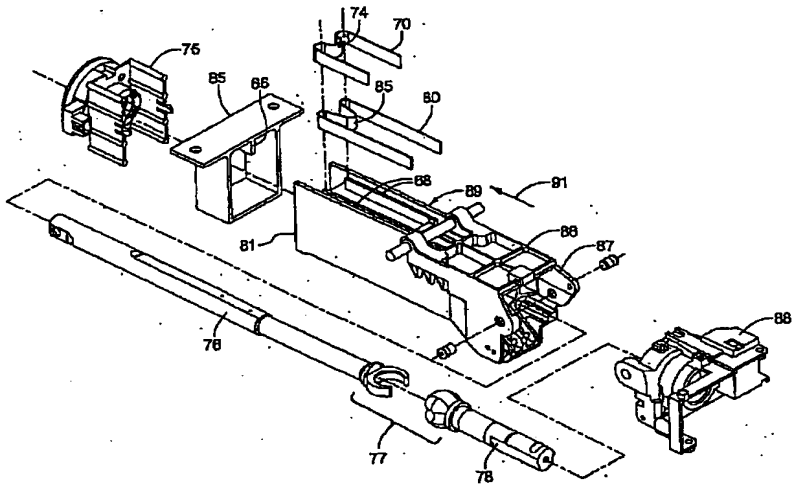


従来技術

【図６】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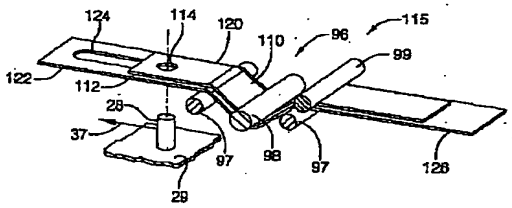
78

【図８】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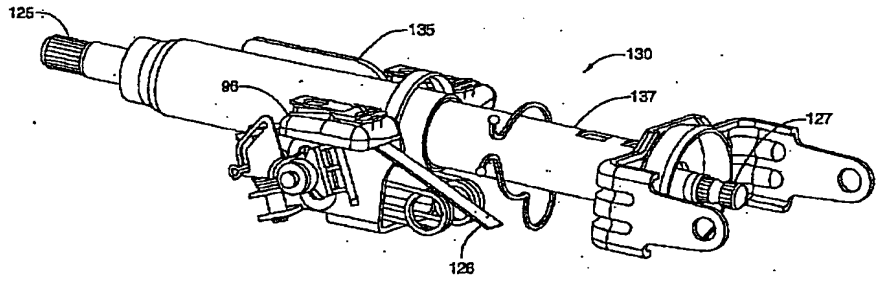
98
97
126
29

【図９】


125
135
130
96
137
127
126

【外国語明細書】

1 Title of Invention

KINETIC ENERGY ABSORBER

2 Claims

1. An energy absorption device comprising:

a first plastically deformable member (30, 70, 110) having a traveling bight;

a second plastically deformable member (40, 80, 120) having a traveling bight;

a pusher (28, 66) attached to a first body (29, 41, 85, 135) proximate a first part of said first member (30, 70, 110);

a catch allowing said second member (40, 80, 120) to move a limited distance with respect to the pusher, said distance having a limit beyond which a first part of said second member (40, 80, 120) is effectively fixed to said pusher;

an anvil arrangement (35, 68, 96) fixed to a second body (45, 86, 137) said anvil arrangement (35, 68, 96) being positioned proximate said traveling bights, said traveling bights having a shape corresponding with an anvil surface of said anvil arrangement (35, 68, 96);

said anvil arrangement (35, 68, 96) arranged to force said traveling bight of said first member (30, 70, 110) to travel along a length said first member (30, 70, 110) upon initial relative movement of said first and second bodies, and cause, upon continued relative movement of said first and second bodies, said traveling bight of said second member (40, 80, 120) to travel along a length of said second member (40, 80, 120) upon said catch reaching said limit, wherein as said traveling bights travel down respective ones of said first (30, 70, 110) and second members (40, 80, 120), significant energy is absorbed and dissipated.

2. The device of claim 1 wherein said first member (30, 70, 110) is significantly shorter than said second member (40, 80, 120).

3. The device of claim 1 wherein said second member (40, 80, 120) has a larger cross-sectional area than said first member (30, 70, 110) (30, 70, 110) when said area is perpendicular to a direction of travel of said first and second members.

4. The device of claim 3, said cross sectional area of said first member (30, 70, 110) and said second member (40, 80, 120) being substantially constant throughout an operative length of said first (30, 70, 110) and second (40, 80, 120)

members, said operative length comprising a portion of said first (30, 70, 110) and second (40, 80, 120) members starting at an initial location of said traveling bight, and ending at said free end.

5. The device of claim 1, said first member (30, 70, 110) and said second member (40, 80, 120) each comprising a plastically deformable metal strap.

6. The device of claim 1 wherein one of said first and second bodies comprises a steering column housing (45, 86, 137) and another of said first and second bodies comprises a vehicle body (41, 85, 135).

7. The device of claim 1 wherein said first member (30, 70, 110) and said second member (40, 80, 120) are configured in a J configuration characterized by each said first portion being at a first end (32, 42) of a respective one of said first and second members (30, 40), each said first and second members (30, 40) also having a free end opposite said first end (32, 42), each said first end (32, 42) and said free end being arranged generally parallel to each other, said traveling bights initially being adjacent to said first (32, 42) end prior to said relative movement of said first and second bodies (29, 135, 137) said first end (32) of said first body (29, 135) being fixed to said pusher (28), said first end (42) of said second body (137) including said catch.

8. The device of claim 7, wherein said first member (30) and said second member (40) are nested against one another.

9. The device of claim 7 wherein one of said first and second bodies (45, 41) comprises a steering column housing (45) and another of said first and second bodies (45, 41) comprises a vehicle body (41).

10. The device of claim 7, wherein said anvil arrangement (35) comprises a sleeve (45), said sleeve (45) being positionable about a steering shaft, said first body (41) comprising a collar (41) concentrically disposable about said sleeve (45), said free end of each of said first and second members extending along an axis of said sleeve (45) and said collar (41).

11. The device of claim 10 further comprising a second first member (30) and a second second member (40) disposed approximately 180 degrees from said first and second members (30, 40).

12. The device of claim 7, said pusher (28) comprising a pin (28), said first member (30) having a hole (34) at said first end (32) through which said pin (28) extends thereby fixing said first end (32) to said pusher (28), said catch comprising an elongated slot (44) formed in said second member (40) cooperating with said pin (28) to permit said limited movement between said pin (28) and said second member (40).

13. The device of claim 1 wherein said first member (30, 70, 110) and said second member (40, 80, 120) are configured in an M configuration, each said first and second members (70, 80) having two free ends (72, 82) generally extending in a first direction, a second traveling bight, and a central bight (74, 85) generally extending in said first direction, said anvil arrangement (68) comprises two anvil surfaces (68) each positioned between said central bight (74, 85) and said free ends (72, 82) and proximate said traveling bight and said second traveling bight of said first and second members (70, 80), said pusher (66) being positioned proximate said central bight (72) of said first member (70); said catch comprising a separation between said pusher (66) and said central bight (85) of said second member (80).

14. The device of claim 13 wherein said first member (70) and said second member (80) are nested against one another.

15. The device of claim 13 wherein one of said first and second bodies comprises a steering column housing (86) and another of said first and second bodies comprises a vehicle body (85).

16. The device of claim 13 wherein said anvil arrangement (68) comprises a recess (89) formed in a steering column housing (86), said recess (89) including said first and second anvil surfaces (68), said pusher (66) comprising a bracket (85) attachable to a body of a vehicle.

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17. The device of claim 1 wherein said first member (110) and said second member (120) are configured in an S configuration characterized by each said first portion being at a first end (112, 122) of a respective one of said first and second members (110, 120), each said first and second members (110, 120) also having an opposite end (126), said traveling bights being adjacent to said first end (112, 122) prior to said relative movement of said first and second bodies (29, 135, 137).

18. The device of claim 17 wherein each said first end (112, 122) and said opposite end (126) being substantially parallel to each other and extending in opposite directions.

19. The device of claim 18 wherein said anvil arrangement (96) comprises at least three anvil surfaces (97, 98), each said first end and said opposite end extending in a common plane.

20. The device of claim 17 wherein said first member (110) and said second member (120) are nested against one another.

21. The device of claim 17 wherein one of said first and second bodies (29, 135, 137) comprise a steering column housing (137) and another of said first and second bodies comprise a vehicle body (135).

22. A kinetic energy absorbing collapsible steering column comprising:

an energy absorbing device absorbing kinetic energy by resisting compressive force against said collapsible steering column (76, 130); the energy absorbing device including a steering column housing (45, 86, 137), a first plastically deformable member (30, 70, 110) and a second plastically deformable member (40, 80, 120) wherein said compressive force being exerted against said steering column housing (45, 86, 137) and causes displacement of said steering column housing 45, 86, 137) and is initially directed through said first member (30, 70, 110) and not said second member (40, 80, 120), and at some predefined point thereafter during said displacement, said compressive force is passed through said second member (40, 80, 120), each of said first and second members . 30, 40, 70, 80, 110, 120) including a traveling bight, said members (30, 40, 70, 80, 110, 120) absorbing said kinetic energy

by forcing said traveling bight to travel a length of said members (30, 40, 70, 80, 110, 120).

23. The steering column of claim 22 wherein said first member (30, 70, 110) is significantly shorter than said second member (40, 80, 120).

24. The steering column of claim 22 wherein said second member (40, 80, 120) has a larger cross-sectional area than said first member (30, 70, 110).

25. The steering column of claim 24, said cross sectional area of said first member (30, 70, 110) and said second member (40, 80, 120) being substantially constant throughout an operative length of said first and second members (30, 40, 70, 80, 110, 120), said operative length comprising a portion of said first and second members (30, 40, 70, 80, 110, 120) starting at an initial location of said traveling bight, and ending at a free end.

26. The steering column of claim 22, said first member (30, 70, 110) and said second member (40, 80, 120) each comprising a plastically deformable metal strap.

27. The steering column of claim 22 wherein said first member (30) and said second member (40) are configured in a J configuration, each said first and second members (30, 40) having a first end (32, 42) and a free end opposite said first end (32, 42), said first end (32) of said first member (30) being fixed to a pusher (28) fixed to one of said steering column housing and a body of said vehicle, said first end (42) of said second member (40) having a catch permitting limited movement of said second member with said pusher (28); said steering column further comprising an anvil arrangement (35) comprising an anvil surface (35) shaped to cooperate with each said traveling bight, said anvil surface (35) being fixed to another of said steering column housing an a body of said vehicle;

each said first end (32, 42) and said free end being arranged generally parallel to each other, each of said traveling bights initially being adjacent to said first end prior to said displacement and traveling toward said free end during said displacement.

28. The steering column of claim 6 27, wherein said first member (30) and said second member (40) are nested against one another.

29. The steering column of claim 27, said pusher (28) comprising a pin (28), said first member (30) having a hole (34) at said first end (32) through which said pin (28) extends thereby fixing said first end (32) to said pusher (28), said catch comprising an elongated slot (44) formed in said second member (40) cooperating with said pin (28) to permit said limited movement between said pin (28) and said second member (40).

30. The steering column of claim 22 wherein said first member (70) and said second member (80) are configured in an M configuration, each said first and second members (70, 80) having two free ends (72, 82) generally extending in a first direction, each of said first and second members further comprising a second traveling bight and a central bight (74, 85) generally extending in said first direction, said steering column further comprising an anvil arrangement (68) comprising two anvil surfaces (68) each positioned between said central bight (74, 85) and said free ends (72, 82) and proximate a respective one of said traveling bight and said second traveling bight of said first and second members (70, 80), said pusher (66) being positioned proximate said central bight (74) of said first member (70); said catch comprising a deep central bight (85) of said second member (80), resulting in a separation between said pusher (66) and said central bight of said second member (85).

31. The steering column of claim 30 wherein said first member (70) and said second member (80) are nested against one another.

32. The steering column of claim 30 wherein said anvil arrangement (68) comprises a recess (89) formed in said steering column housing (86), said recess (89) including said first and second anvil surfaces (68), said pusher (66) comprising a bracket (85) attachable to a body of a vehicle.

33. The steering column of claim 22 wherein said first member (110) and said second member (120) are configured in an S configuration wherein each of said first and second members (110, 120) includes a first end (112, 122) and an opposite

end (126), each said traveling bight being adjacent to said first end (112, 122) prior to said displacement, said traveling bights being forced to travel by an anvil arrangement (96).

34. The steering column of claim 33 wherein each said first end (112, 122) and said opposite end (126) being substantially parallel to each other and extending in opposite directions.

35. The steering column of claim 33 wherein said anvil arrangement (96) comprises at least three anvil surfaces (97, 98), each of said first end (112, 122) and said opposite end (126) extending in a common plane.

36. The steering column of claim 33 wherein said first member (110) and said second member (120) are nested against one another.

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3 Detailed Description of Invention

TECHNICAL FIELD

The present invention relates to a kinetic energy absorption mechanism having applicability to vehicular collapsible steering columns.

BACKGROUND

Kinetic energy absorption devices are known for use in vehicles to reduce the likelihood of injury in the case of an accident. Such devices come in many different forms. One form that is particularly effective at absorbing significant quantities of energy in a relatively small amount of space employs a plastically deformable member, such as a plastically deformable metal wire or strap, a pusher, and an anvil across which the plastically deformable member is drawn, dissipating energy as the member is deformed. The member is initially bent to form a traveling bight which is positioned over the anvil. As the pusher draws the member over the anvil, the traveling bight travels down the length of the strap.

An example of this technique is described in U.S. Patent 5,788,278, issued August 4, 1998 to Thomas et al., which is wholly incorporated herein by reference. In this patent, a metal strap is formed into a rough M shape with the two legs much longer than the web extending between them. Each leg of the M is positioned on opposite sides of two anvils, and a central pusher is positioned between the two anvils. The pusher is attached to the body of the vehicle, while the pair of anvils are attached to a steering column housing. Upon the instance of a forward collision, the driver is expected to impact the steering wheel which will impart a compressive force on the steering column housing, causing the anvils to move past and on either side of the pusher. The metal strap will be drawn across the anvils as the center is pushed down between them.

Although the use of a plastically deformable member is an effective and reliable means for absorbing significant quantities of kinetic energy in a compact

space, it has heretofore been impossible to use this technology to adequately vary the amount of resistance in response to various loads. Because vehicular accidents occur with varying degrees of severity, it would be desirable to provide an energy absorption device that will provide a smaller amount of resistance in the case of a less sever collision, and a greater amount of resistance in the case of a more sever collision.

Prior attempts at using a plastically deformable member to vary the amount of resistance with displacement of the steering column housing have been inadequate. This is because the most difficult design performance centers on the desire to begin with a low force level and transition to higher levels. U.S. Patent 5,375,881, issued December 27, 1994 to Lewis, shows in Figure 2a a metal strap that is utilized in a manner similar to that described above with reference to U.S. Patent 5,778,278 above, but in this case, there are no anvils. Instead, Lewis relies on the bending and tensile strength to keep the "free" ends from buckling under compression while the inner part is under tension, in effect, pulling the bight down. The use of an anvil is preferred, since the effect of friction between the traveling bight and the anvil is desirable, and the risk of buckling is eliminated through the use of anvils.

The strap in Figure 2a of Lewis has a varying cross section. Specifically, the Lewis strap includes a narrower section in the middle, at the vicinity of the pusher, and wider sections toward the bottom of the opposite legs. Because of the narrower section in the middle, there is a reduced initial resistance which increases when the traveling bight reaches the wider sections. The problem with this design is that the strap may fracture if the transition to the high force exceeds the tensile strength of the narrower section. Since the narrow portions of the strap have just been significantly worked by bending, the tensile strength of the narrower sections may be significantly compromised. Because of the increased resistance due to friction between the anvils and the traveling bights, this risk is heightened if anvils are used.

U.S. Patent 5,026,092, issued June 25, 1991 to Abramczyk, describes an energy absorbing steering column having a passive restraint load limiting column support system adapted to come into play only when the primary energy absorbing system, whatever it may be, fails to provide the energy absorbing controlled collapse of the steering column assembly as designed, or one which is adapted to come into play only upon receiving impact loads of greater magnitude than those for which the

system was designed. This system includes a steering column support bracket that is design to fracture under high impact, allowing the steering column to move upwardly in a second degree of freedom. The steering column will then impact the instrument panel, causing its plastic deformation and that of the instrument panel itself, thereby providing additional required energy absorption. (See column 5, lines 10-50 of Abramczyk.) This system does not provide the kind of energy absorption characteristics desired of a collapsible steering column, but rather dispenses with the utility of a collapsible steering column entirely at impact loads greater than a specified threshold.

SUMMARY

The disadvantages of the prior art noted above and otherwise are overcome by a kinetic energy absorption device suitable for use with a collapsible steering column that includes a first and second plastically deformable member have a traveling bight, a pusher proximate to a first part of the first member attached to a first body, a catch allowing the second member move a limited distance with respect to the pusher, and an anvil arrangement fixed to a second body. The anvil arrangement is positioned proximate the traveling bights, which have a shape corresponding with an anvil surface of thereof. The anvil arrangement forces the traveling bight of the first member to travel along a length of the first member upon initial relative movement between the first and second bodies, and then forces the traveling bight of the second member to travel along a length of the second member.

DETAILED DESCRIPTION

These and other features will be appreciated by reference to the detailed description and accompanying drawings.

Figure 1 schematically shows the operation of a known kinetic energy absorption device 5 employing a J-strap configuration. Strap 10 includes a traveling bight that is looped over anvil 15. A first end 12 of strap 10 is pulled in the direction of arrow 14 away from anvil 15. Free end 16 of strap 10 is then pulled towards and around anvil 15, causing the traveling bight to travel down the length of strap 10.

Figure 2 shows a partially exploded view of a varying-resistance energy absorption device 25 employing a J-strap configuration. Pin 28 is fixed to a first support 29 and anvil 35 is mounted to a second support (not shown). Anvil 35, in this instance, is cylindrical and may rotatably supported so that it is free to rotate on its axis. Pin 28 is positioned in hole 34 of first strap 30 and slot 44 of second strap 40. During an event for which energy absorption is required, pin 28 moves away from anvil 35 in the direction of arrow 37. Initially, pin 28 pushes against first end 32 of first strap 30, causing first strap 30 to be pulled around anvil 35 as previously

described with respect to Figure 1. Pin 28 therefore acts as the pusher in this embodiment. During this time, pin 28 travels in slot 44 formed in second strap 40, and so second strap 40 remains stationary with respect to anvil 35. However, once pin 28 reaches the opposite end of slot 44, it operates as a catch, limiting further relative motion between the second strap 40 and the pin 28. Pin 28 then begins to pull second strap 40 from first end 42 thereof.

Figure 3 shows an exemplary implementation of the multi J-strap configuration described above with respect to Figure 2. In this case, a collar 41 is concentrically disposed about a sleeve 45 and the steering wheel shaft (not shown). Collar 41 is fixed to a body of a vehicle (not shown) while sleeve 45 is attached to a steering column housing. Upon impact, sleeve 45 is forced to the left as shown in the drawing to pass through collar 41, which remains stationary with the vehicle. Collar 41 includes a pair of pins 28 which extend through apertures 34 formed in respective first straps 30, of which two are shown. Second straps 40 include respective slots 44 along which pins 28 travel during a first portion of the energy absorbing movement. As sleeve 45 moves to the left, anvils 35 formed into sleeve 45 push against a traveling bight formed in first straps 30, causing first straps 30 to bend around anvils 35, thereby generating a resistive force and absorbing kinetic energy.

At some point, pins 28 will reach a position in slots 44 opposite from that shown, and pins 28 will then hold first ends 42 of straps 40 stationary with respect to collar 41. When this happens, further movement to the left of sleeve 45 will cause the respective free ends of straps 40 to be pulled toward and around anvils 35, thereby significantly increasing the resistance and therefore energy absorption.

A second embodiment of the invention will now be described with reference to Figures 4-6. Figure 4 schematically shows the operation of a known kinetic energy absorption device 55 employing an M-strap configuration. Strap 60 includes two traveling bights looped over respective anvils 68. A central bight is placed adjacent pusher 66. As a force is applied on pusher 66 as represented by arrow 66, free ends 62 of strap 60 are drawn around respective anvils 68, causing the traveling bights to travel down the length of the free ends of strap 60. Note here that anvils 68 may be rotatably supported or not, depending on whether additional friction resistance is desired.

Figure 5 shows a schematic representation of a varying-resistance energy absorption device 65 employing an M-strap configuration. Pusher 66 is fixed to a first support (not shown) and anvils 68 are mounted to a second support (not shown). During an event for which energy absorption is required, pusher 66 moves in the direction of arrow 67 with respect to anvils 68. Initially, pusher 66 pushes against first strap 70, at central bight 74 causing the first strap 70 to deform with free ends 72 being drawn around respective anvils 68. During this time, second strap 80 remains stationary in its position as pusher 66 has yet to contact second strap 80. However, once pusher 66 reaches central bight 84 of second strap 80, pusher 66 begins to pull the central portion of second strap 80 away from anvils 68, causing free ends 82 of second strap 80 to be pulled around respective anvils 68. In this way, pusher 66 and recessed central bight 84 of second strap 80 cooperate as a catch, the recess of central bight 84 permitting limited relative motion between said pusher and said central bight 84.

Figure 6 shows a partially exploded diagram of an exemplary implementation of a varying resistance energy absorption device employing an M-strap configuration as described above with respect to Figure 5. Telescopically-collapsible steering shaft 76 is positioned within a steering column housing 86 and supported at a forward end by bearing support 75 and at a second end by a bearing in an enlarged, reinforced rear end 87 of steering column housing 86. Steering shaft 76 is connected to an upper shaft 78 by universal joint 77; upper shaft 78 is positioned in tilt housing 88.

Bracket 85 is fixed to a body of the vehicle (not shown) while steering column housing 86 is positioned more with respect to a steering wheel (not shown). Steering column housing 86 includes a cavity 89 which houses the energy absorption device as will now be described. Cavity 89 includes a pair of anvils 68 upon which a first strap 70 and a second strap 80 are nested. A first end 81 is inserted through bracket 85 and attached to bearing support 75. Bracket 85 includes a pusher 66 which is aligned with central bights 74 and 84 of first and second straps.

In the case of a frontal collision, the driver will impact the steering wheel (not shown) and the force thereof will be transferred to steering column housing 86, which will be urged forward in the direction of arrow 91. Anvils 68, being

attached to steering column housing 86 will push first and second straps 70 and 80 forward. Pusher 66 of stationary bracket 85 will initially contact central bight 74 of first strap 70, causing first strap 70 to be pulled across anvils 68. At some point thereafter, pusher 66 will reach the location of the central bight 84 in second strap 80, then causing second strap 80 to be pulled across anvils 68, thereby significantly increasing the resistance and therefore energy absorption.

A third embodiment will now be described with reference to Figures 7-10. Figure 7 schematically shows the operation of a known kinetic energy absorption device 90 employing an exemplary S-strap configuration. The S-strap configuration is usually characterized by a plastically deformable strap 100 and bending configuration wherein a first end 102 and a second end 104 move together during the energy absorption process, with at least two traveling bights therebetween that travel down the length of the strap, although this is by no means a requirement of the S-strap configuration. In the configuration of Figure 7, strap 100 includes several traveling bights arranged in an anvil arrangement 96 that includes two bending surfaces 97 formed in a block 105, and a central roller 98, and a stay roller 99. A first end 102 of strap 100 is pulled in the direction of arrow 94 away from anvil arrangement 96. Free end 104 of strap 100 is pulled towards anvil arrangement 96, causing strap 100 in contort around the various bending surfaces, thereby dissipating a significant amount of energy. It should be noted that although three traveling bights are shown in this example, any combination or number of bends may be used. An example of a known S-strap configuration using only two bends is disclosed in U.S. Patent 5,605,352, issued February 25, 1997 to Riefe et al.

Figure 8 shows a schematic representation of a partially exploded varying-resistance energy absorption device 115 employing an S-strap configuration. Pin 28 is fixed to a first support 29 and anvil arrangement 96 is fixed a second support (not shown). Anvil arrangement 96, in this instance, includes a plurality of rollers 97, 98, and 99. During an event for which energy absorption is required, pin 28 moves away from anvil arrangement 96 in the direction of arrow 37. Initially, pin 28 pushes against first end 112 of first strap 110, causing first strap 110 to be pulled through anvil arrangement 96 as previously described with respect to Figure 7. Pin 28 therefore acts as a pusher in this embodiment. During this time, pin 28 travels in slot

124 formed in second strap 120, and so second strap 120 remains stationary with respect to anvil arrangement 96. However, once pin 28 reaches the opposite end of slot 124, it begins to pull second strap 120 from first end 122 thereof. In this way, pin 28 and slot 124 operate as a catch allowing only limited movement between second strap 120 and anvil arrangement 96. Although first strap 110 is shown as being somewhat shorter than second strap 120, this does not have to be the case. Thus, the work of the force pulling pin 28 and anvil arrangement 96 apart can be absorbed by first the first strap 110 and then the second strap 120, or by first the first strap 110, and then both the first and second straps 110, 120.

Figure 9 shows a diagram of an exemplary assembled collapsible steering column 130 implementing the varying resistance energy absorption device employing an S-strap configuration as described above with reference to Figure 8. Steering column 130 includes an upper steering column housing 137 that is coaxially received in a lower steering column housing 135. Coaxially received within upper and lower steering column housings 137, 135 are upper and lower steering shafts 127, 125, which are telescopically collapsible within the respective housings. Upper and lower steering column housings 137, 135 are attached at a mid-point by a frangible connection (not shown) so that upon impact of a compressive force of sufficient strength, the frangible connection will shear, and allowing the compressive force to be absorbed by first and second straps 110, 120, shown in Figure 10. Although only the free end 126 of second strap 120 is visible extending from anvil arrangement 96, it will be understood that the opposite end of the straps will be pulled as described above with reference to Figure 8, thereby causing at first a first amount of resistance, and then a second amount of resistance as the upper and lower steering column housings are collapsed.

While the invention has been shown and described with respect to several embodiments, it is to be appreciated that these embodiments are exemplary only of the invention, and are not limiting. For example, although the first strap in each embodiment is shown as being somewhat shorter than second strap, this does not have to be the case. Thus, the work of the pusher and anvil can be initially absorbed by the first strap and then the second strap, or initially by the first strap, and then both the first and second straps. If the second strap has a greater bending strength than first

strap, a significantly increased resistance will be realized upon the pusher reaching the central bight of the second strap, even if the free end of the first strap has completely passed across the anvil arrangement.

Furthermore, the plastically deforming members do not have to take the form of flat metal straps as shown. Various other cross section shapes may be utilized, such as round, square, oval, etc. Moreover, the cross sectional areas do not need to be uniform throughout the operative length of the member as shown. For example, Figure 7 of U.S. Patent 5,788,278 (fully incorporated herein) shows a modified metal strap having a gradually reduced cross section towards the free end, thereby customizing the energy-absorbing characteristic of the plastically deformable member.

Furthermore, while only two straps are shown nested together, it is contemplated that any number of straps may be nested together or placed adjacent to one-another employing the same principle wherein additional straps are called into play as the displacement from an initial condition increases. In addition, while a catch comprising a pin and slot arrangement is shown for the first and third embodiments, any type of catch arrangement could be substituted therefore.

Furthermore, while all the embodiments shown employ an anvil arrangement for bending the traveling bight, an anvil arrangement, while preferred, is not absolutely necessary as described in the background portion of this document. One of ordinary skill could conceive of modifications to the described embodiments sans the anvil arrangement.

Therefore, as will be appreciated by one skilled in the art, these and many other variations are possible without departing from the spirit and scope of the invention.

4 Brief Description of Drawings

Figure 1 is a schematic representation of a prior art energy absorption device using a J-strap;

Figure 2 is a schematic representation of a varying-resistance energy absorption device using a J-strap configuration;

Figure 3 is an exemplary implementation of the energy absorption device of Figure 2;

Figure 4 is a schematic representation of a prior art energy absorption device using an M-strap;

Figure 5 is a schematic representation of a varying-resistance energy absorption device using an M-strap configuration;

Figure 6 is an exemplary implementation of the energy absorption device of Figure 5;

Figure 7 is a schematic representation of a prior art energy absorption device using an S-strap;

Figure 8 is a schematic representation of a varying-resistance energy absorption device using an S-strap;

Figure 9 is an exemplary implementation of the energy absorption device of Figure 8; and

Figure 10 is a pair of S-straps used in the implementation of Figure 9.

18

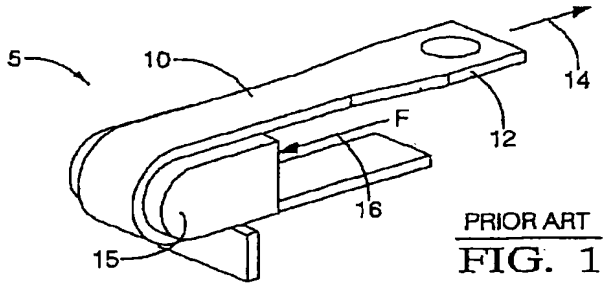
kinetic energy absorption device 5
strap 10
first end 12
arrow 14
anvil 15
end 16
varying-resistance energy absorption device 25
pin 28
first support 29
first strap 30
first end 32
hole 34
apertures 34
anvil 35
arrow 37
second strap 40
collar 41
first end 42
slot 44
sleeve 45
kinetic energy absorption device 55
strap 60
ends 62
varying-resistance energy absorption device 65
pusher 66
arrow 66
arrow 67
anvils 68
first strap 70

19

ends 72
central bight 74
bearing support 75
steering shaft 76
universal joint 77
upper shaft 78
second strap 80
first end 81
ends 82
central bight 84
bracket 85
steering column housing 86
rear end 87
tilt housing 88
cavity 89
known kinetic energy absorption device 90
arrow 91
arrow 94
anvil arrangement 96
two bending surfaces 97
central roller 98
stay roller 99
plastically deformable strap 100
first end 102
second end 104
block 105
first strap 110
first end 112
varying-resistance energy absorption device 115
second strap 120
first end 122

20

slot 124
lower steering shafts 125 and 127
end 126
assembled collapsible steering column 130
lower steering column housing 135
upper steering column housing 137



PRIOR ART
FIG. 1

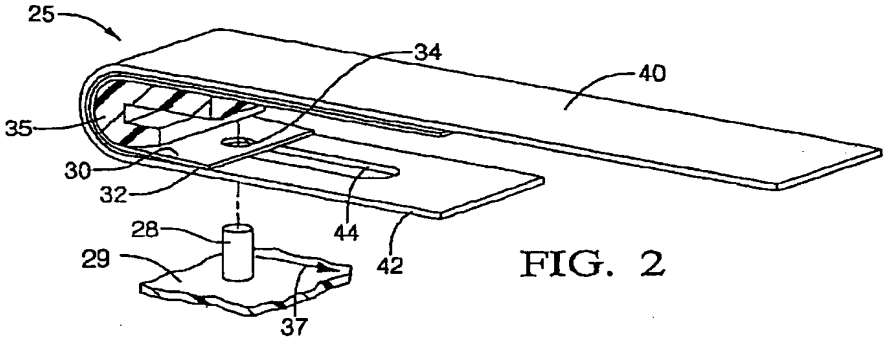


FIG. 2

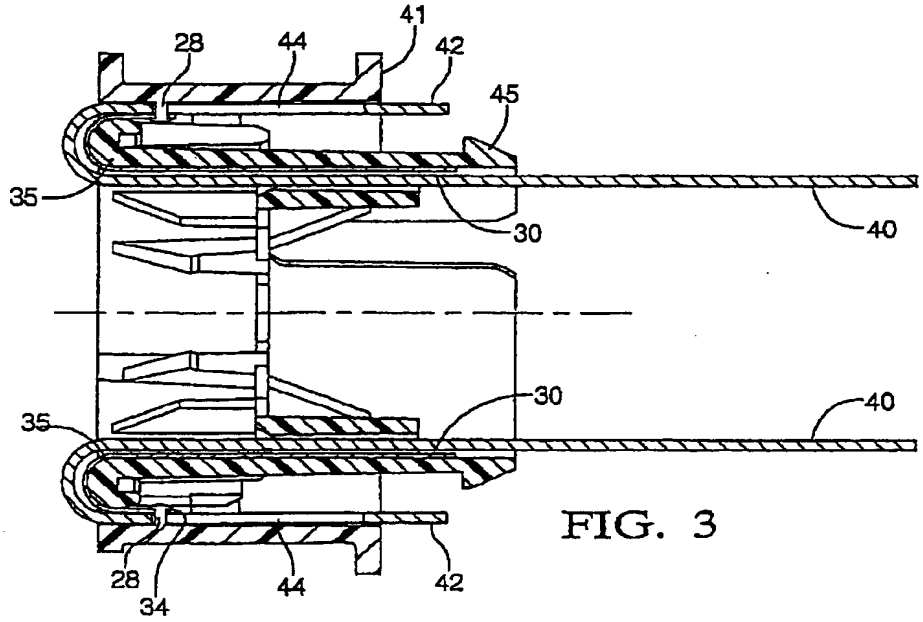
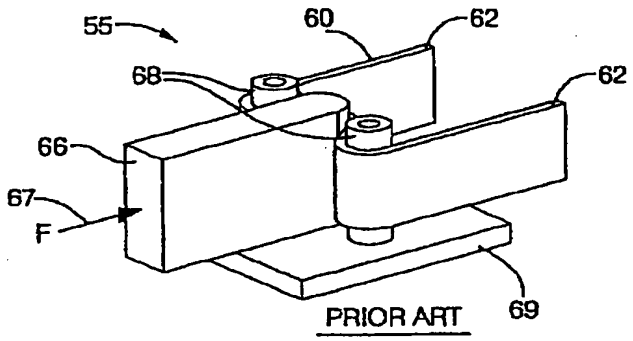


FIG. 3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PRIOR ART

FIG. 4

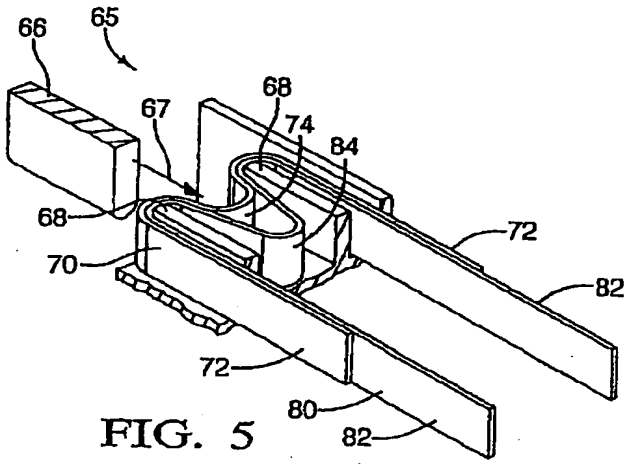
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FIG. 5

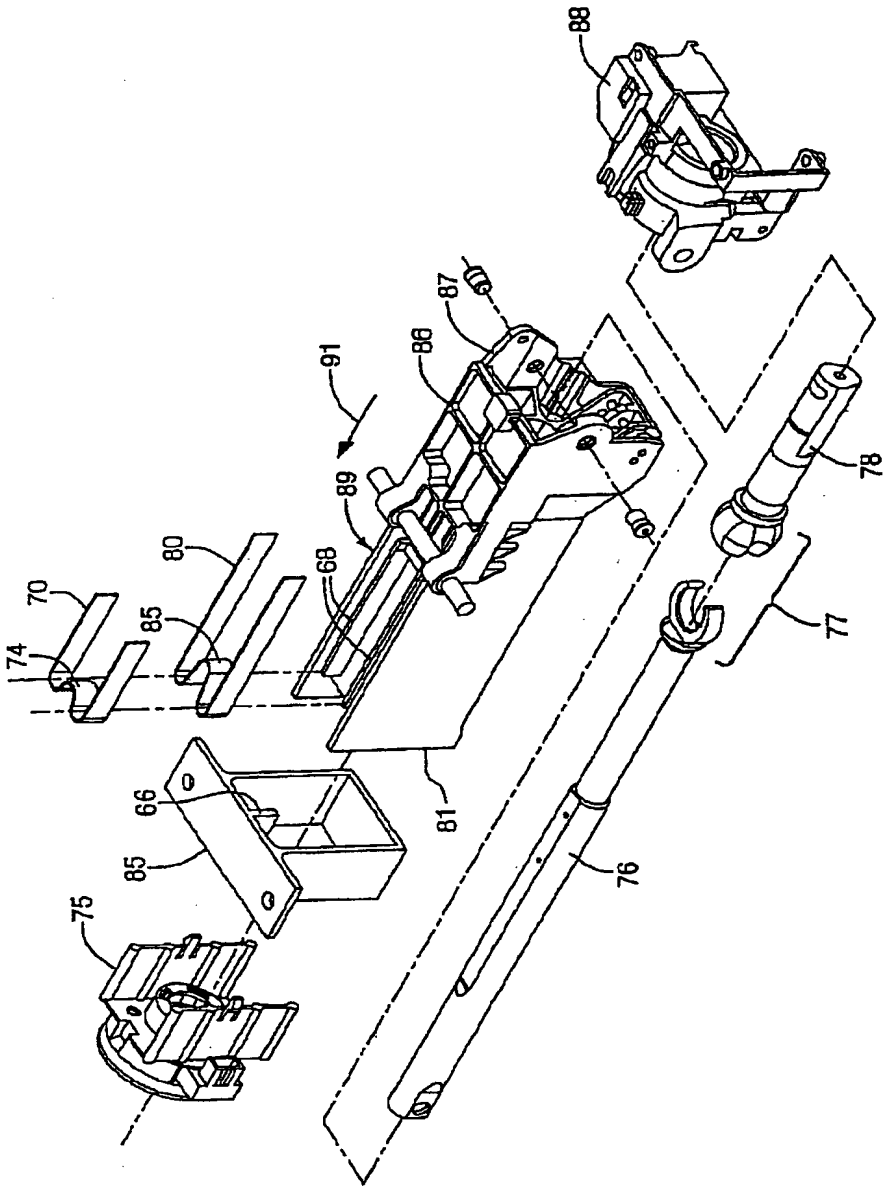
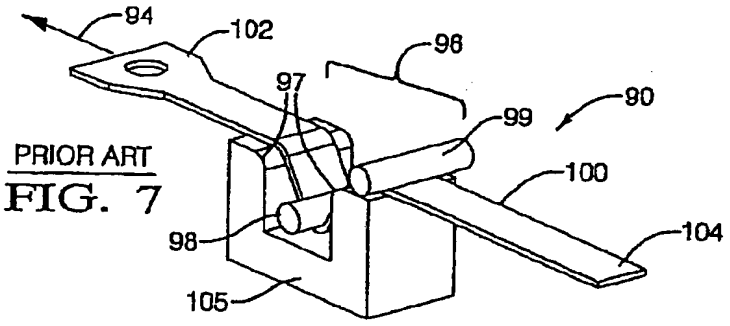


FIG. 6



PRIOR ART
FIG. 7

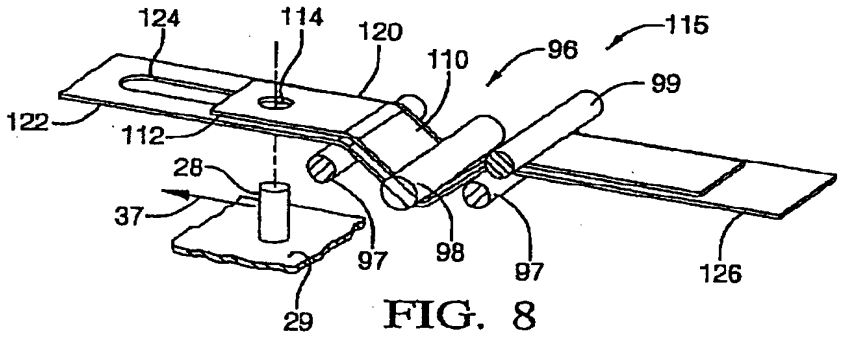


FIG. 8

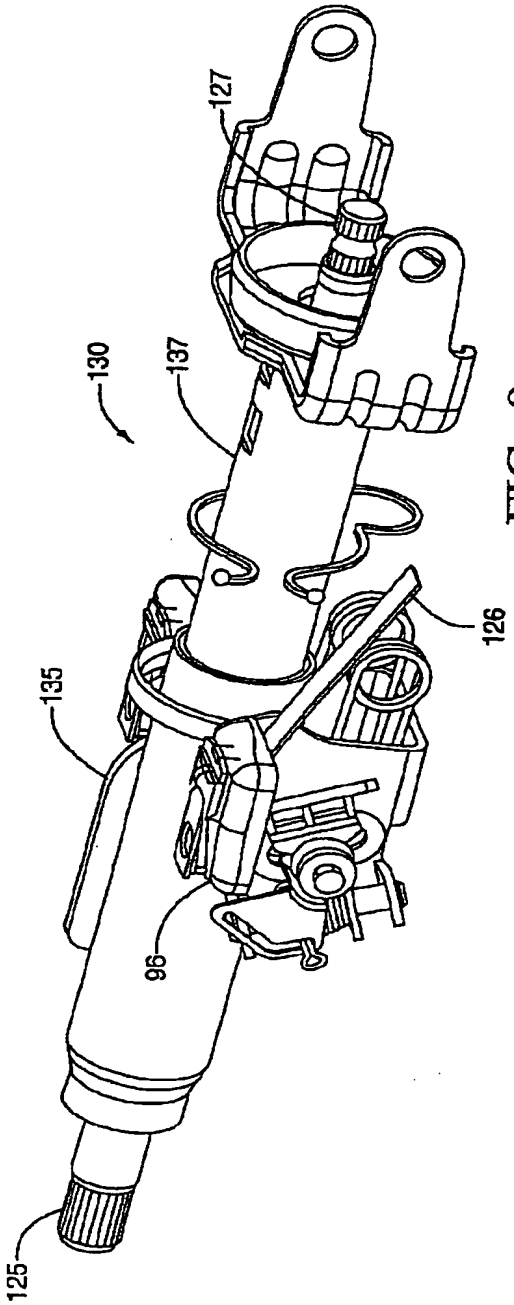


FIG. 9

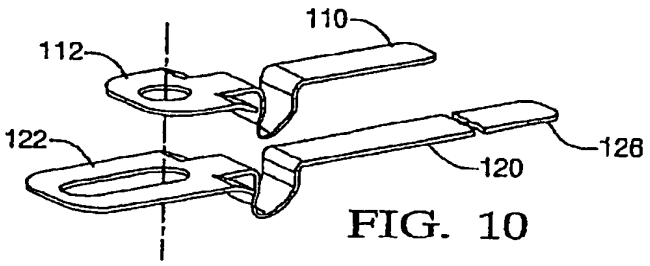


FIG. 10